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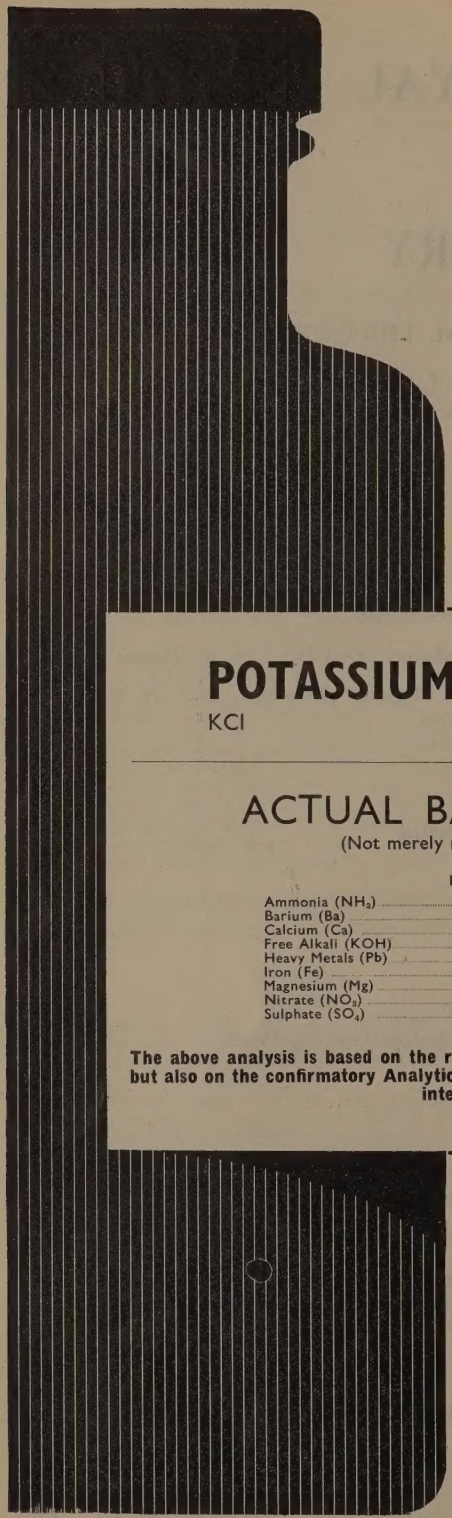

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TECHNICAL TRAINING MOVES AHEAD

The White Paper recently published (*Better Opportunities in Technical Education*, Cmnd 1254, H.M.S.O.; 1*s*. 3*d*. net) presents the results of a comprehensive study of our present system of technical education and makes proposals which, it is hoped, will remedy many of its defects. In the past there has been an appalling waste of time, effort and resources because many of our young people have taken the wrong road on leaving school—either through lack of the right advice or lack of appropriate facilities. The situation as regards chemistry was noted by the Joint Committee for National Certificates about two years ago (*J*., 1959, 213). Our technical colleges are not meeting the requirements of industry, particularly the demand for more and better trained technicians, craftsmen and operatives, nor the needs of the various types of students, if the high wastage through non-completion of courses or failure in examinations can be taken as an indication. One of the reasons for this is the haphazard method of selecting students for courses without sufficient regard to their abilities and aptitudes. Another, for many boys and girls who leave school at 15, is the discouraging prospect of having to spend a year in a preliminary course at an evening institute before they can be admitted to a technical college. These preliminary courses inevitably bear little relationship to the students' educational requirements or to the technical college courses to which they aspire. The evening institutes no longer fit into the modern pattern of technical training where a continuity in further education must be established and recognized as a normal process by more and more school-leavers. They should provide mainly non-vocational courses.

The main proposals in the White Paper are:

(*a*) Students should begin to study at a technical college immediately after leaving school; preliminary courses in evening institutes should be discontinued;

(*b*) Ordinary National Certificate courses will last two years instead of three. The standard of entry will be raised and normally four appropriate passes at G.C.E. 'O' level will be required;

(*c*) There will be new specially-devised courses of four or five years' duration for technicians;

(*d*) New general courses will be introduced. These will be mainly diagnostic and may lead to either an O.N.C. course or one of the new technicians' courses;

(*e*) Craft and operative courses will be developed and broadened to give a more liberal foundation;

(*f*) More time should be provided for study under day-release schemes. No student should have to rely wholly on evening study.

From all this there emerges a more regular pattern for the future in technical education in which pupils who are about to leave school will be able to see a broad choice of routes to success. Closer co-operation between schools, technical colleges and industry will mean that the young worker will be treated as an individual, his needs studied and good advice given to him on the course most suited to his aptitude and ability. A broader education, too, with more mathematics and science and, perhaps more important, additional practice in the use of the English language will benefit both employee and employer.

The nation cannot afford waste in any form, least of all in the education of its young people, and if we are prepared to invest a little more now we can hope to reap a higher return in the future. The Government is providing the facilities. Industry is asked to play its part by providing the materials, by releasing the young men and women to the technical colleges and giving them the necessary time to study. Day-release is essential, and if this can be extended to one-and-a-half or two days a week, so much the better. Nor should it be overlooked that this applies to girls as much as to boys.

Somewhat similar proposals for Scotland were announced in another White Paper (*Technical Education in Scotland—the Pattern for the Future*, Cmnd 1245, H.M.S.O.; 1*s*. net) published at the same time. Again the course for the Ordinary National Certificate is to be reduced to a period of two years, entry being restricted to students with the necessary passes in the new Scottish Certificate of Education. The two years of the course will, from 1962, occupy at least 30 weeks per session with a minimum 225 hours of study in each session based on a broader syllabus. Students not reaching the required standard for entry to a National Certificate course would be advised to take a course with somewhat lighter theoretical content, with a prospect of later transfer should their performance justify it. The provision of more and varied courses at the operative, craft and technician levels will be explored, and again employers are exhorted to grant more day-release to their young workers than is given at present. The Scottish Education Department is very much perturbed that day-release in Scotland is available for only about 10 per cent of young people under the age of 18 who are in insured employment. This compares with about 20 per cent in England and Wales, which itself is far from a satisfactory level.

The entry requirements for Associateships of central institutions and similar courses are to be reviewed in the light of these developments. A new training course for teachers in further education will shortly be introduced, and appropriate certificates awarded.

R. W. F.

THE BRITISH CHEMICAL INDUSTRY

By C. J. THOMAS, B.SC., M.SC. (ECON.)

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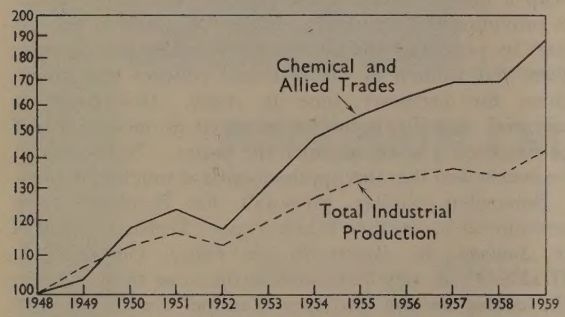
PART II*

A CHANGING INDUSTRY

No industry is more worthy of the description 'dynamic' than the chemical; its achievements in increasing production and productivity (to which allusion will be made later) and in the pioneering of new products are sufficient indication of this. The dynamic nature of the industry is revealed by a number of statistical measures. First consider production. As we see from the graph, the growth of production of

OUTPUT: CHEMICAL AND ALLIED TRADES AND ALL MANUFACTURING TRADES (United Kingdom)
(1948=100: Ratio Scale)



Source: National Institute Economic Review, May 1960, Table 2.

chemicals since World War II has greatly exceeded that of industrial production as a whole in the U.K. The proportion of the total manufacturing labour force engaged in chemical production increased from 1·9 to 2·2 per cent over the same period so that the greater part of the increase in output is accounted for by a growth of productivity. In the period 1907–24 the average rate of productivity increase, as measured by the growth of output per operative-hour, was below the average for manufacturing industry as a whole, but since then it has been above average, taking first place among all manufacturing industries in the period 1949–55, with an average rate of increase equal to double that of manufacturing industry as a whole (Table VII).

Thus expressed, one is liable to attribute the increase in production to an increase in the efficiency of labour, forgetting the increased amount of capital equipment working in conjunction with that labour. Very recently some preliminary statistics have been published[1] with which an attempt has been made to measure changes in efficiency or 'progress' in an industry, taking into account changes in the amounts of both capital and labour. In the period 1948–54 'progress' in the chemicals group was at the rate of 3·4 per cent compound per annum—a relatively high rate, but not so high as in wood and cork manufacturing (5·0 per cent), paper and printing (4·6 per cent) and 'other manufacturing' (3·6 per cent).

The dynamic character of the chemical industry is nowhere more apparent than in the methods adopted for providing the large-scale raw material requirements

* Continued from *J.*, 12.

TABLE VII

PRODUCTION AND PRODUCTIVITY MOVEMENTS IN THE UNITED KINGDOM

	Average rate of productivity; increase per cent per annum.*				
	1907–24	1924–35	1935–49	1949–55	1907–55
Total Manufacturing	2·0	2·0	2·0	3·1	2·1
Building materials	1·9	2·1	2·3	2·5	2·1
Chemicals	1·3	2·3	2·7	6·2	2·5
Metal manufacture	1·1	1·7	1·2	3·3	1·5
Engineering, etc.	1·3	1·3	1·0	3·3	1·4
Vehicles	5·1	3·7	4·0	3·9	4·3
Metal goods	2·4	1·7	1·3	1·8	1·8
Precision instruments, etc.	0·6	3·3	2·2	1·2	1·8
Textiles	0·7	2·3	2·0	1·4	1·5
Leather	2·1	0·7	1·1	−0·3	1·2
Clothing	1·8	1·5	0·3	2·0	1·3
Food, drink and tobacco	1·2	1·0	1·6	0·5	1·2
Timber trades	2·4	1·0	0·1	5·3	1·8
Paper and printing	3·2	1·0	2·5	4·2	2·6
Other manufacturing	1·3	3·6	2·1	4·3	2·4

* Output per operative-hour.

Source: K. S. Lomax, 'Production and Productivity Movements in the United Kingdom since 1900,' *J. R. statist. Soc.*, 1959 (2), 203, Table 8.

for the manufacture of the new products, such as man-made fibres, plastics and detergents, and in the way some of the sectors (despite the complexity of the manufacturing processes involved) have grown and greatly changed the nature of their output. In the course of a few years a heavy organic chemical industry, based on petroleum raw materials and second only to that of the U.S.A., has come into being. By 1959 petroleum-based chemicals constituted 50 per cent of the total output of organic chemicals with an increase to 65–75 per cent likely by 1965 or so. Before the Second World War heavy organic chemical manufacture was almost entirely confined to alcohol, acetone and some coal-tar products. The features of this development are briefly discussed in the next section; pharmaceuticals and plastics have been given brief consideration in an appendix as examples of sectors which are growing rapidly, although paints, dyestuffs, insecticides and industrial explosives are other important growth points.

PETROLEUM CHEMICALS

The development of the petroleum chemical industry is of considerable interest. Investment on a colossal scale has been necessary to bring the industry into existence: up to the end of 1958, £75 m. had been invested, the scale being stepped up in 1959 and 1960, when it is likely that a further £65 m. were invested, bringing the total to the end of 1960 to approximately £140 m. Firms entering such a new industry are inevitably faced with substantial development problems, their time-tables and budgets are all too prone to go wrong and so they obviously have to possess large resources and staying power. It is not surprising therefore that the firms which have been most prominent in the petroleum chemicals field are Shell, I.C.I., B.P., Distillers and Esso, respectively the first, second, third, ninth and fourteenth largest public companies operating wholly or partly in Britain, classified by asset size. Even some of these companies have not been disposed to shoulder the risks on their own. I.C.I. and Shell, the latter through its subsidiary Shell Chemical Company, have proceeded alone and are now the largest producers of petroleum chemicals. Others have preferred to form associations to share the burden; B.P. and Distillers, for example, have formed British Hydrocarbon Chemicals and this latter, in association first with Monsanto and then with the Oronite Chemical Co. (U.S.), formed Forth Chemicals and Grange Chemicals respectively. These firms produce the complex organic chemicals and their related products. Esso, on the other hand, has gone half-way only, contenting itself with supplying feedstocks to Monsanto and International Synthetic Rubber and Union Carbide, all of which firms have established works close to Esso's Fawley refinery. British Celanese was one of the earliest British firms in the field, producing ethanol from ethylene.

The mixed parentage of the petroleum chemical industry is the outcome of the chemical companies' search for feedstocks and the oil companies' search for outlets for waste refinery gases. Within the last two years, however, there has been an almost complete change-over to 'naphtha' as feedstock: some 94 per cent of ethylene capacity is now based on naphtha, the remainder on refinery gas. This crossing-over of industrial boundaries by firms to produce petroleum chemicals has probably resulted in the expertise and techniques of the oil refining industry, in particular those relating to continuous manufacture and the handling of fluids, permeating more quickly and to a greater extent into the manufacture of organic chemicals than they would otherwise have done; batch production has, as a consequence, been declining in importance. Indeed, it has only been by the development of continuous processes, making possible great economies in handling between the several stages of the process, and relying largely on developments in instrumentation and automatic control, that large-scale economic production, not only of the basic chemicals for the manufacture of plastics, synthetic fibres and detergents but also of the end-products, has been possible.

CONCLUSION

The chemical group of industries is buoyant and continually changing, supplying the rest of manufacturing industry with increasing quantities of raw materials, many of them with novel and desirable characteristics catering for new and previously unimagined needs. Progress in chemistry and in chemical production is continually adding to the amenities of life, and, as human needs appear to be insatiable, the industry can confidently be expected to progress in the future. Accompanying such progress there are frequently problems of excess capacity, for as new products come into being the demand for some older products sometimes declines, but the industry has the dynamism, in a growing economy, to take such problems in its stride.

APPENDIX

The Pharmaceutical Industry

This industry, today employing some 50,000 persons, was virtually non-existent before the First World War. In 1957 the output of drugs and pharmaceutical preparations was valued at £150 m. compared with £19 m. in 1935 and £15 m. in 1924. The higher general price level is partly responsible for the high value in the post-war period, but the increase is mainly the result of the growth of the industry—a growth which was especially great in the period 1935–50 when the labour force more than doubled. Within the same period not only was there a general growth of production but the composition of the industry's output has changed very greatly: antibiotics are important and there are many

new synthetic drugs such as the sulphonamides, the various antimalarials, vitamins and hormones, as well as new biological products. This dynamism and progressiveness is linked with the rapid progress of the sciences of chemistry, pharmacology and bacteriology and the industry's own research efforts to avail itself of the benefits which progress in these sciences can confer.

The industry is very varied, embracing a wide range of production activities and many different techniques. Production in this industry can involve *inter alia* the simple extraction of drugs from plants, the manufacture of simple fine chemicals, or complex syntheses of drugs, such as the corticosteroids and the hormones, and fermentation processes for antibiotics; the numerous biological products involve techniques for culturing bacteria in nutrient media, or sera and antitoxins in the bodies of animals. For the latter purpose large studs of horses are usually employed—Burroughs Wellcome, for example, have a stud of some 500 animals. Besides this variety of basic therapeutic substances further variability is imposed by the need to compound or prepare the ingredients in a variety of ways for administration to different subjects in varying circumstances. Quantities vary enormously from a total output of a few lb, as in the case of vitamin D_2, for example, to sulphonamides, barbiturates and antimalarials produced in hundreds of tons, and to aspirin in thousands of tons.

There are perhaps 260 firms (or because of combinations[2] among them, 230 business units) engaged in pharmaceuticals manufacture, and approximately 260 establishments employing more than 10 persons, but owing to difficulties of definition not all establishments engaging in pharmaceuticals manufacture on a large scale are classified under the industry; *e.g.* much of the aspirin is made in establishments classified with chemicals (general) and I.C.I. Pharmaceutical Division's production of basic drugs (being usually carried on in I.C.I. establishments mainly producing other chemical products) is largely excluded from the statistics relating to the drugs and pharmaceutical preparations trade. In 1951 and also in 1954 some 13 per cent of the output (by value) of pharmaceutical products came from establishments classified under other industries.

Medicinal fine chemicals with an extensive non-medicinal use are usually manufactured in the other chemical trades, mainly the chemicals (general). On the whole, however, the manufacture of the basic ingredients is carried on within the trade, as are the subsequent processes, namely formulation and packaging.

As we see in Table VIII there were 22 establishments (8·4 per cent of the total number) devoted mainly to the production of pharmaceutical chemicals: these were the larger establishments, and together they employed 14·4 per cent of the total labour force. It is in these establishments that the more complex production processes are carried on. The majority of establishments (nearly 80 per cent) are devoted mainly to the production of pharmaceutical preparations, a process involving formulation without any necessary production of basic ingredients. In such establishments wholesaling is a frequent accompaniment. Some of the establishments in this group, particularly the larger ones, produce therapeutic ingredients as well. The 31 establishments in the third group undertake the production of a variety of pharmaceutical products, including surgical goods and toilet preparations.

There is a broad distinction between firms in regard to the method of sales-promotion adopted: some 130 adopt the 'ethical' policy[3] with sales promotion confined to doctors and the trade press: they are the manufacturers of prescription drugs, usually sold under proprietary names. About 80 firms produce publicly advertised drugs and the simple medicines only, and there are about 20 firms producing both kinds. As the publicly advertised medicines are usually simple in composition, the processes involved in their manufacture are usually uncomplicated, so that they are often conducted on a large scale by mechanized processes in establishments of moderate size. These latter establishments will be in groups (2) and (3) of the table, while

TABLE VIII

DRUGS AND PHARMACEUTICAL PREPARATIONS TRADE

Analysis according to specialization within the trade[1] (United Kingdom, 1951)

Trade or specialization within the trade[2]	Establishments		Gross output		Net output		Persons employed		Net output per person employed
	No.	%	£000	%	£000	%	No.	%	£
Specialist producers of pharmaceutical chemicals	22	8·4	17,257	14·7	9,482	15·5	6,967	14·4	1,361
Specialist producers of pharmaceutical preparations	208	79·5	80,091	68·1	42,624	69·9	31,382	65·0	1,358
Remainder of trade	31	11·9	20,083	17·1	8,886	14·6	9,956	20·6	893
Total	261	100·0	117,431	100·0[3]	60,992	100·0	48,305	100·0	1,263

1. Larger establishments (employing more than 10 persons) only.
2. 50 per cent or more of sales were in these lines.
3. Totals are not always equal to aggregate of columns because of rounding errors.

Source: Census of Production Report, 1954.

those specializing in drugs sold partly or mainly on prescription are in groups (1) and (2). The scale of production varies greatly: some firms specialize in branded (or proprietary) products and, whether they advertise publicly or not, they tend to have a small range of products and relatively large outputs. Others, who combine branded products with common drugs which are not advertised, frequently produce a wide range of products; they have formidable production planning problems to cope with, as batches have to be changed so frequently.

Research. Research is particularly important to the industry to enable it to maintain or improve its position. 'Innovational' research[4] to discover new therapeutic agents is largely a matter of trial and error and so becomes very costly, with only the larger firms with considerable interest in the manufacture of pharmaceutical chemicals able to afford it. Formulation research, designed to present existing drugs in new forms improved in regard to methods of their administration, is more widely undertaken, as also is process research to develop more economical methods of production.

At the present time the industry is spending some £5 m. per annum on research, a figure double what it was 10 years ago.[5] More than half this expenditure is accounted for by Glaxo Laboratories, I.C.I. Pharmaceuticals Division and Burroughs Wellcome. It is only relatively infrequently that really outstanding drugs are discovered, but the British industry has significant achievements to its credit, for example, synthetic antimalarial and antileprosy drugs, and new and improved vaccines for many diseases, from poliomyelitis to whooping cough, besides many other less notable discoveries.

The Industry and the National Health Service. The development of the industry has undoubtedly been considerably influenced by the inauguration of the National Health Service, which initially made drugs available free and later at a small prescription charge, to all according to need. But even if there had been no National Health Service the industry could not have failed to grow, and to grow considerably, under the stimulus of the post-war prosperity of the British economy and the undoubted advantages of the new drugs. Another concomitant of the growth in the demand for drugs has been the attraction of many foreign firms to this country. The entry of these firms has conferred advantages on the British economy in that the benefits of foreign advances in drugs have been made available here by a relatively smaller expenditure of foreign currency than would have been necessary if the ready-made drugs had to be imported.

In the National Health Service the industry is faced with a virtually monopolist buyer of prescription drugs, albeit a monopolist with incomplete control of purchases since it operates through a medical profession free to prescribe the drugs required by the patient. Conscious of its power, the Service has required drug manufacturers to reveal details of profits and as, in many instances, the profit rates have appeared to be high, the industry has at times attracted some unsavoury publicity. High profits, however, are to be expected on newly introduced drugs as costly development charges have to be recovered. There have been prolonged negotiations between the Ministry of Health (which operates the N.H.S.) and the prescription drug section of the industry (through the latter's trade association, the Association of British Pharmaceutical Industry) to devise methods of pricing which will ensure a correspondingly higher return to the firms that undertake research than to those that do not, these latter to receive a rate of profit acceptable to the Ministry.

Fruitful research culminates in the building of new manufacturing plant or the extension of old. In 1959 capital equipment involving expenditure of some £8 m. came into use, while this year the figure seems likely[6] to reach £12 m. Expenditure on this scale indicates a considerable degree of confidence within the industry—as there should well be, since the demand for pharmaceutical products is likely to grow; certainly this section of the chemical group of industries seems destined to continue to make progress and to be prosperous.

The Plastics Industry

The manufacture of plastics materials is a distinctly chemical operation, undertaken today by some 50 firms employing between them 26,000 persons and operating (in 1957) 62 plants or establishments. The value of the plastics materials produced in these plants in that year was some £118 m.

It is a young industry having its origin in recent scientific and technological developments. Its growth has been phenomenal: total output increased almost 20 times between 1939 and 1959, in which year over 500,000 tons of plastics of all kinds were produced. Today plastics form a very important part of our industrial raw materials, their volume exceeding that of the non-ferrous metals used and being equal to two-fifths of the volume of hardwood or a seventh of the volume of steel.

This century has witnessed the creation of a demand for plastics materials of many kinds. The natural plastic substances, shellac and bitumen, became important in the manufacture of newly developed articles, the former for phonograph records and the latter for acid-resisting battery cases. Today these natural plastics are relatively unimportant and over 95 per cent by weight of the plastics used are 'artificial.'

The first of the artificial plastics was celluloid, and the British Xylonite Co. began its manufacture in this country in 1877. It was introduced as a substitute for elephant ivory and was first of all made into billiard balls, piano keys and knife handles but other uses soon

followed, particularly in the new industries of photography and cinematography for which it soon became an essential material. Casein plastics, made from a natural product, milk, were the next to be manufactured in the U.K. (1915).

Today the vast majority of plastics are 'synthetic.' The first such plastic was Bakelite, named after a Belgian, Leo Baekeland, who made a thermosetting substance from phenol and formaldehyde in the U.S.A. in 1907. It was first produced in the United Kingdom during the 1914–18 war. This material could be used for producing mouldings with high electrical resistance and had been developed in time to promote the radio boom of the twenties. Urea-formaldehyde plastics came into production in the U.K. in 1928 and like the phenolics they were thermosetting but could be produced in more attractive colours.

Until 1933 only five man-made plastics were in use: two of them, nitrocellulose and cellulose acetate, were *thermoplastic* and three, phenol-formaldehyde, urea-formaldehyde and casein, were *thermosetting*. Since then a range of new synthetic thermoplastic materials has come into production and today the plastics field includes, in addition to the above, acrylics, alkyds, cellulose acetate butyrate (c.a.b.), epoxides, nylon, Terylene, polystyrene, polytetrafluoroethylene, polythene, polyvinyl chloride, polyvinylidene chloride, silicones and various synthetic rubbers.

Research and development play a very important part in this industry. The greatly increased understanding of the chemistry of high polymers has resulted in the ability to make products of more or less predetermined pattern with certain desired properties. So successful, in fact, have chemists been in this connection that plastics, at first regarded by users as substitutes or convenient replacements for traditional materials, are today frequently the preferred materials.

The U.K. is now the third largest producer of plastics materials in the world, exceeded only by the U.S.A. and Germany, but exports account for a considerably larger proportion of output in the U.K. than in these other two countries. In 1959 over 157,000 tons, or some 30 per cent of total output, valued at nearly £40 m., was exported, and these figures are exclusive of the large quantities of plastics included in other exported finished products. In 1959 consumption *per capita* in the U.S. was 27 lb, whereas in the U.K. it was 17·5 lb, so that it appears that there is considerable scope for expansion of consumption in this country.

The expansion rate of plastics production in the last decade has been five times that of total industrial production. From 1950 to 1959 the production of plastics increased by some 200 per cent compared with a 26 per cent rise in total industrial production and 58 per cent in chemicals and allied industries, and it must be remembered that this latter term includes pharmaceutical manufacture and oil refining, two trades which have grown considerably more than the average of the group. Today the plastics trade accounts for 6–7 per cent of the total output of the chemical and allied trades.

The growth has not been evenly spread over all plastics. From 1950 to 1959 the output of thermoplastics grew by 500 per cent compared with 77 per cent for the thermosetting materials. Among the thermoplastics, polystyrene, polyvinyl chloride and polythene, especially the last two, are making the greatest advances: outputs in 1959 were 30,000, 85,000 and 90,000 tons, respectively. Despite this great growth, the older products, nitrocellulose and casein, while not expanding, are continuing to hold their existing markets.

The plastics industry can be considered as an offshoot mainly of the chemical and mineral-oil refining industries, as these supply most of its raw materials. There are three main types of raw materials: (i) those occurring naturally, such as bitumen and shellac; (ii) chemically modified naturally occurring materials such as nitrocellulose and casein, and (iii) minerals, *e.g.* coal and petroleum. Group (iii) is by far the most important and provides the basis for 90 per cent of all plastics materials. Coal yields the intermediates phenol, urea, naphthalene and acetylene, while petroleum provides ethylene, acetic acid, butadiene and some phenol. About 45 per cent of all plastics are now derived from petroleum and there are prospects of a considerable expansion. Moreover, since the production of the intermediates themselves and of the plastics derived from them are distinctly chemical operations, it is hardly surprising that a number of plastics producers have their origin in closely allied fields. Thus I.C.I., Shell, Distillers, Courtaulds and Monsanto Chemicals have embarked on plastics production as logical extensions of their other activities. There are also some specialist companies such as Bakelite, British Xylonite and British Industrial Plastics, which not only produce the plastics materials but also undertake the moulding processes to produce finished articles. In the main, however, producers do not undertake moulding. The manufacturing processes are usually continuous and highly automated; in consequence a high proportion of the labour force (which is small compared with that of some other industries with equal turnover) is made up of technicians and scientists; over one-third of the labour force engaged in plastics materials manufacture is non-manual.

The future of this industry seems assured. Polythene production, which has grown so rapidly, is likely to continue its upward trend: capacity already exists for an increase of a third in output, made up of I.C.I. with 90,000 tons additional capacity, Distillers Plastics Group with 12,000 tons, Union Carbide/Bakelite 1,000 tons and Monsanto 10,000 tons. High-density polythene, with a higher softening point than ordinary polythene, rendering it suitable for products requiring sterilization by boiling water, is being increasingly produced.

Recently, polypropylene has come into production, Shell Chemical Company and I.C.I. being able to produce up to 20,000 tons and 10,000 tons respectively this year. Since the plastics industry produces the raw materials for so many other industries, its prospects of continued expansion are bound up with the future of industry as a whole.

REFERENCES

1. W. B. Reddaway and A. D. Smith, 'Progress in British Manufacturing Industries in the Period 1948–54,' *The Economic Journal*, March, 1960, No. 277, Vol. LXX, pp. 17–37.
2. *See J.*, 12, reference 2.
3. A term used within the trade, and devoid of any 'moral' significance.
4. Or as it is usually called within the industry, 'fundamental' research, a term which should not be taken to imply academic research pursued with no immediate practical aim in view.
5. Yet despite such a rapid increase the British industry is lagging behind the smaller Swiss industry reported to be spending £7 m. annually. The U.S. industry, so much larger than the British, is spending £43 m. (See Chapter II of the Final Report of the Committee on the Cost of Prescribing. H.M.S.O., 1959.)
6. *See Manufacturing Chemist*, May, 1960.

SUGGESTIONS FOR FURTHER READING

1. W. B. Reddaway, 'The Chemical Industry,' a chapter in Duncan Burn (ed.), *The Structure of British Industry*, Vol. I. Cambridge University Press, 1958.
2. C. J. Thomas, 'The Pharmaceutical Industry,' a chapter in Duncan Burn (ed.), *The Structure of British Industry*, Vol. II. Cambridge University Press, 1958.
3. Association of British Chemical Manufacturers, *Report on the Chemical Industry*, 1949 (86 Strand, W.C.2).
4. *Financial Times Review of the Chemical Industry*, 1957 and 1959.
5. *Chemical Age*. Annual Reviews, 9 Jan., 1960, 10 Jan., 1959, 11 Jan., 1958.
6. J. H. Dunning and C. J. Thomas, *British Industry: Change and Development in the Twentieth Century*, Hutchinson, 1961.

PRODUCTIVITY IN PRACTICAL ORGANIC CHEMISTRY

By L. H. W. HALLETT, M.A., B.SC., F.R.I.C. and
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Any drive for increased productivity must be severely handicapped where premises and equipment are old and no longer adequate for present-day needs. Conversely in moving to modern premises with modern equipment one would expect increased productivity.

In the summer of 1959 the Chemistry Department of Rutherford College of Technology made such a move from its old home at Bath Lane, Newcastle upon Tyne, to the modern building at Northumberland Road. Many advantages were immediately obvious in the new building with its new equipment. Courses below A1 were transferred to the branch college and there were thus fewer students in more spacious premises and the old problem of overcrowding had largely disappeared. It soon became obvious, however, that the more spacious premises presented problems of their own and that increased productivity would not be automatic, for without care much time could be wasted in the search for, and assembly of, apparatus in a large laboratory.

The shortage of time available in the laboratory becomes especially acute with the part-time student. It is essential to use this limited time to the best advantage and to that end the elimination of wasted time is one of the first objectives, as in any other productivity drive. A student learns no practical chemistry in his journeyings round the laboratory in search of apparatus and the means of assembling it. This can lead to a sense of frustration which, in extreme cases, causes the student to question whether, after having set up the apparatus, there is sufficient time left to make a start on the actual experiment. Nevertheless, it would be just as bad to go to the other extreme and have every experiment so carefully prepared that the student had little more to do than 'press the button.'

In the practical organic chemistry course at Rutherford we have endeavoured to provide a reasonable compromise between the two extremes. The purchase of new equipment for the building presented a great opportunity. It was decided to issue students with a set of apparatus sufficient to cover all the common operations—distillation, refluxing and so forth. Such a set had to be robust and readily assembled, and for that reason apparatus with standard ground-glass joints was selected. Locker space is very much at a premium in part-time courses, where many students use the same laboratory in the course of a week, and the semi-micro scale thus had an added attraction, additional to other well-known advantages, in that a complete set of apparatus is sufficiently compact to keep in a locker.

None of the commercial sets seemed to be exactly what we desired, and we therefore enlisted the aid of a local glassblower to manufacture a set to our own design. It consisted of 25 pieces and was standardized principally on the B14 joint, this size giving more ready access for cleaning. All flasks were made with single necks and conversions were effected by the use of adaptors. This gives maximum flexibility, but in some distillations there is a rather large dead space.

In the commercial sets examined we noted many useful features, and we freely acknowledge any of these that we may have adapted and incorporated in our own set, in particular the idea of Stock and Fill in assembling the apparatus in clips attached to a board.

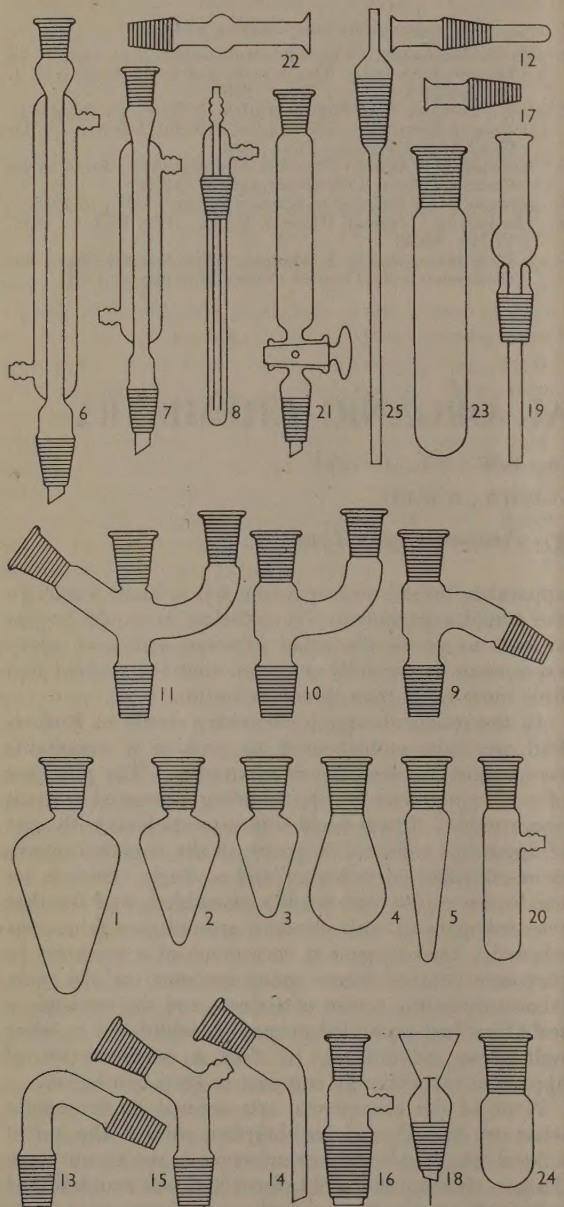


FIG. 1. Components of the set of semi-micro apparatus

In the session 1959–60 one of these 25-piece sets was stored in each locker shared by two students in the A2 level and upwards. Experience there, albeit rather limited, showed that this was not ideal; certain items were hardly ever required while others were required at the same time by both students. Accordingly the plan has been modified, and details of the set to be issued for 1960–61 will be found in Appendix I.

Even with this apparatus there were still two main potential sources of wasted time. The first—that of selecting the components required—has been tackled by issuing the set in a box of simple design and construction where all the pieces can be readily seen and withdrawn as required. As the box has a flat top it does not really reduce the floor or shelf space in the locker; and when in the box the whole set is more readily portable—another important consideration in a large laboratory where students often have to work at a distance from their lockers. The second problem is the assembly of the apparatus. The collection of the traditional retort stands, clamps and bosses can waste much time and it has other disadvantages, such as encumbrance of the working space on the bench top and a lack of flexibility that can often cause breakages. We have therefore devised our own simple rig on a sheet of hardboard to which is attached 1 in. cubes of wood carrying Terry clips. This board hooks on to a shelf for the reagent bottles and so carries the various assemblies at the back of the bench with hardly any incursion on the working space. The board is equipped with rubber tubing for the water supply to the condensers, which are fed in series from a tap below the shelf for reagent bottles. The Terry clips hold the apparatus securely and yet give the flexibility that is conspicuously absent from the traditional mounting. This flexibility facilitates assembly and reduces breakages. With this simple new rig, the whole assembly in a rather complex arrangement, such as a distillation under reduced pressure, can be carried on a single base, making it more convenient and less vulnerable. The details of operation are outlined in Appendix III.

At the A2 level in 1959–60 the apparatus was used principally for analytical work where it has proved very useful for such operations as the separation of mixtures, preparation of derivatives and recrystallizations. Preparative work during that time was continued on a larger scale with existing sets of instructions. This involved the temporary issue of larger apparatus with consequent loss of time, and it is therefore hoped that for 1960–61 it will be possible to reduce all the organic practical work in A2 to the semi-micro scale. Details of the construction of the boxes and the rig for assembling the apparatus are given with sketches as appendixes to this article.

When designing the apparatus simplicity in construction and the feasibility of production in reasonable numbers without elaborate workshop facilities were borne very much in mind; as a result, about 50 of the boards have been produced in the department at a cost of about 5–6*s*. each, excluding any labour charge.

APPENDIX I

Semi-Micro Apparatus with ground-glass joints

1 SET (*i.e.* for issue to 2 students sharing one locker and working in same class) for PERMANENT ISSUE

Diagram Number	FLASKS	1959–60	1960–61
1	Large pear-shaped	1	2
2	Medium pear-shaped	1	2
3	Small pear-shaped	1	2
4	Kjeldahl type r.b.	1	2
5	Thimble type	1	1
	CONDENSERS		
6	Long Liebig	1	2
7	Shorter Liebig	1	2
8	Cold finger	1	0
	ADAPTORS, ETC		
9	Distillation Head	1	1
10	2-necked adaptor	1	1
11	3-necked adaptor	1	0
12	Thermometer pocket	1	1
13	Angular adaptor	1	1
14	Receiver adaptor	1	1
15	Receiver adaptor with sidearm	1	1
16	B14–B19 adaptor with sidearm	1	1
17	Stopper B14	1	4*
	FILTRATION		
18	Filter funnel and nail	1	1
19	Pregl filter	1	0
20	Filtration tube with sidearm	1	1
	MISCELLANEOUS		
21	Separating funnel	1	1
22	Drying tube	2	0
23	Sublimation tube	1	0
24	Crystallizing dish	1	2
25	Gas leak	1	0

*2 of these 4 stoppers are of polythene

APPENDIX II

(*a*) *Construction of the Board*

The board (Fig. 2) was constructed from ¼in. hardboard supplied cut to the required size of 30 × 18in. Two coats of cream emulsion paint were applied first of all. The holes required were drilled from a template with batches of up to six sheets clamped together in a vice. The elliptical holes were cut individually by chiselling

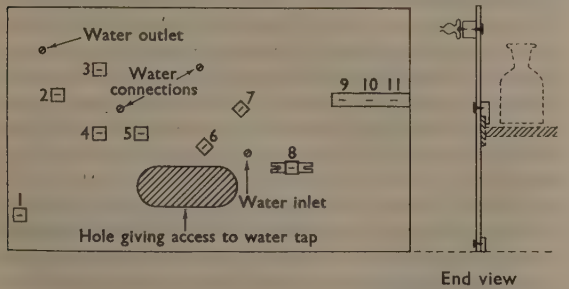


FIG. 2. Front View showing Layout of Clips

to link up two 3in. holes. The wooden blocks of 1in.³ were readily produced in a simple jig from 1in.² section timber purchased for the job. In use, the boards hooks on to the reagent-bottle shelf; the wooden hooks for this purpose are indicated in the end-view sketch. Timber of the appropriate cross-section was obtained in long lengths and cut into 2 in. pieces, three of these being attached for rigidity. A 1 × ⅜in. strip was also attached to the bottom edge of the board for rigidity. The sketch indicates how the various pieces of wood are secured by wood screws from the opposite side of the headboard. The Terry clips were then attached to the centres of the wooden blocks; all were size 80/1, except in positions 2 and 9, where they were 80/3. Position 8 had to be adjustable to cope with slight variations in overall dimensions of the apparatus, and this adjustment was obtained by mounting that block on a strip of laminated plastic slotted at each end to slide along one screw and to be held where required at the other by a bolt carrying a wing nut. The four small holes carry the rubber tubing for the water supply to the condensers, and the eliptical hole gives access to the tap supplying this water. The waste is taken off at the left-hand side, this being adjacent to the sink when the board is attached to the left end of the bench as intended.

The method of attaching to the bench for operation will not be of general application as benches are not identical in different buildings. It should be quite easy to devise a method of attachment to suit each individual case. For example, in many cases a strip of wood could be secured to uprights on the bench where no suitable shelf with beading exists.

(*b*) *Construction of the Box*

A large number of wooden boxes of interior dimensions approximately 12 × 18 × 3in. were available in the Stores and these were hinged together in pairs (Fig. 3). One was fitted with a strip of

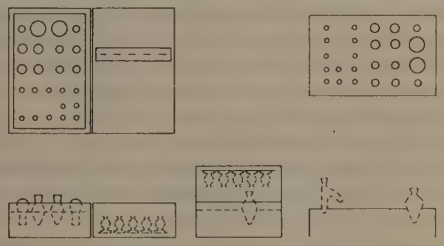


FIG. 3. Box to hold Apparatus

wood carrying five Terry clips to hold four condensers and the separating funnel. In the other there was placed (without being attached to the box) a simple stand, consisting of a piece of hardboard fitted with wooden strips at each end to provide a stand and drilled with holes of appropriate sizes for the various components. This is indicated in a series of sketch plans.

APPENDIX III

Assembly of Apparatus on the Board

Position 1 is used for filtration and is conveniently near a water pump at the end sink.

Position 2 is used for sublimation and carries the 'cold finger'.

Positions 3 and 4 are used for refluxing, and for recrystallization from volatile and inflammable solvents. Position 3 carries the shorter condenser.

Positions 5 and 6 are used for distillation in its various forms. In all of these the flask is mounted in 5. For simple distillation the longer condenser is carried in 6 and the receiver adaptor without side-arm is used. In other cases the condenser is carried in 7 and the receiver adaptor with the side-arm is used, being carried in the adjustable position 8.

Position 9 carries a melting-point bath and the remaining two positions are for general use.

On installing the board on the bench the two condensers are immediately placed in position and coupled up to the water-supply, the board carrying suitable pieces of rubber tubing for this purpose. The addition of the cold finger is optional. The melting-point bath is worth adding on most occasions. The remainder of the apparatus will then be in the portable box where it can readily be seen and withdrawn as required. Thus one has ready to hand the means for carrying out all the common operations for practical organic chemistry.

Book Reviews

CRYSTAL STRUCTURES. SUPPLEMENT V. R. W. G. Wyckoff. *New York: Interscience Publishers Inc.; London: Interscience Publishers Ltd,* 1960. 200*s*.

The Fifth Supplement contains additions to chapters 2–15, and consists of 137 pages of tables, 203 of illustrations, 219 of bibliography and 120 of indexes. However, since a supplement can hardly be criticized in isolation, and since this great work has not yet been noticed in the Institute's *Journal*, I will avail myself of this opportunity to describe the whole.

Dr Wyckoff is one of the founding fathers of X-ray crystallography, and as far back as 1931, into the second edition of his book, *The Structure of Crystals*, he introduced a comprehensive summary of all structures then known. He took the word 'structure' to mean the positions of all, or some of, the atoms in the crystal. In 1934 he published a supplement to this summary. What was then relatively a trickle of new information has swelled into an ever-increasing torrent; Dr Wyckoff therefore embarked on a new venture, *Crystal Structures*, the first volume of which was issued in 1948. This was followed at intervals by four other volumes, and from time to time supplementary material has also appeared, this Fifth Supplement now completing the work.

The arrangement is as follows: the first 12 of the 15 chapters occupy Volumes I, II and III, and deal with the elements, and with inorganic compounds of increasing complexity up to the silicates. Chapter 13 (Volume IV) deals with aliphatic compounds, and chapters 14 and 15 (Volume V) with aromatic and other cyclic compounds. Within each chapter the material is subdivided into four sections: text, tables, illustrations and bibliography. At first sight this subdivision is confusing, since a particular substance will appear in at least three different places. But the scheme—once mastered—is not difficult to follow; and it is altogether essential to the concept of the work, which is in loose-leaf format, so that supplementary pages could be inserted into their proper places as they were supplied. (This Supplement includes an Inventory so that the proper assembly of the pages can be checked.)

In general, compounds are put into an order suggested by their crystal symmetry and formula type, *e.g.* $R(MX_2)_n$. This is satisfactory for enabling one to trace a particular inorganic compound, and in any case there is a formula index. For organic compounds the scheme works less well, since there may be little correlation between molecular structure and crystal symmetry. However, a name index of organic compounds has now been provided, and this removes any serious difficulty here. Coverage of the literature is to the end of 1954, with a few early 1955 references added; in addition, the references given in the 1931 and 1934 monographs, which are now out of print, have been included in supplementary bibliographies.

The illustrations deserve mention. Drawn specially for each well-determined structure, and very beautifully executed, they give as good an impression of the spatial arrangement and packing of the atoms and molecules as seems attainable without recourse to stereoscopy.

This effort to summarize all crystal structure determinations inevitably challenges comparison with *Structure Reports*, and their antecedent *Strukturberichte*. The scope of the latter is different, as it interprets 'structure' rather more liberally, does not confine itself exclusively to *crystal* structures, and is issued as yearly volumes (albeit with a considerable time-lag). Wyckoff's compilation comes out well in the comparison, for, besides being equally reliable, it has greater unity of style and—at the moment—it is rather more up to date. This is not a work that many individuals will be able to afford, though it cannot be regarded as unduly expensive at an accumulated cost of under £45. Certainly all considerable chemical libraries ought to have a set of 'Wyckoff,' including this final Supplement.

J. C. SPEAKMAN

RECENT ADVANCES IN BIOCHEMISTRY. Fourth Edition. T. W. Goodwin. Pp. vi + 301. *London: J. & A. Churchill Ltd,* 1960. 50*s*.

The first three editions of this book, under the above title, were written by Professor J. Pryde, but the last revision was made in 1931 and 'recent' no longer applies to the advances which had then been so well summarized. The fourth edition, written by Professor Goodwin, is a completely new work. The author was a pupil of mine and for many years a colleague, and I must declare a predisposition towards liking his book. It is, however, so manifestly competent that the task of reviewing it can be undertaken with pleasure and an easy conscience.

The book has eight substantial chapters, each dealing with a topic on which there is now much research activity. The aim is to bridge the gap between general textbooks and specialized review articles, and a very real effort has been made to cope with the pedagogic difficulties met at the Honours level of teaching and reading.

Chapter 1 deals with electron transport and oxidative phosphorylation. Oxidation of $DPNH_2$ (which should now be designated reduced nicotinamide-adenine dinucleotide NAD) and succinate through the cytochrome system is well explained. The use of uncoupling agents and inhibitors applied to mitochondrial and other preparations is discussed, as is the role of metalloflavoproteins. The functions of lipids, including the ubiquinones and vitamins K, are also considered in relation to oxidative phosphorylation in animal tissue, in plants and in bacteria. Then follows a section on photosynthetic

phosphorylation, a snapshot of the present state of knowledge seen largely through D. I. Arnon's work.

The next chapter deals with the fixation of carbon dioxide, through the ribulose-diphosphate cycle, through reduced pyridine nucleotides and by means of carboxylases acting on energy-rich compounds such as phosphoenolpyruvic acid and acylcoenzymes A. Carboxylations involving carbamyl phosphate are discussed in relation to the modified ornithine cycle for the synthesis of urea. Other aspects of carboxylation are treated briefly.

Chaper 3 deals with the chemistry and biosynthesis of phospholipids. Recent work (1954–59) corrects the structures proposed (1951) for the plasmalogens. The pattern of biosynthesis of lecithin worked out by Kennedy and others involves *glycerokinase* leading to L-α-glycerophosphate, which condenses with two molecules of acylcoenzyme A to form phosphatidic acid. Choline forms phosphorylcholine (*cholinekinase*) at the expense of ATP, and cytidine triphosphate then forms cytidine-diphosphate-choline under the action of a *transferase*. The phosphatidic acid loses inorganic phosphate through a specific phosphatase and the resulting D-1,2-diglyceride unites with cytidine-diphosphate-choline to give lecithin and cytidine monophosphate under the action of another transferase. This scheme is discussed in detail, and extended to the biosynthesis of kephalins and plasmalogens. There is also a discussion of the sphingomyelins and the inositol phospholipids.

Chapter 4, entitled biosynthesis of the aromatic ring, ranges widely. There is first a very clear account of the shikimic acid pathway in micro-organisms from glucose via *inter alia* dehydroquinic acid, shikimic acid and prephenic acid to phenyl pyruvate and hydroxyphenyl pyruvate to phenylalanine and tyrosine. The part played in this research by the use of mutants is expounded effectively. This section is followed by descriptions of the biosynthesis of thyronine, nor-adrenaline, adrenaline, tryptophan and serotonin. Birch's theory of acetate as a precursor of aromatic compounds is summarized, and the pyruvate pathway for the synthesis of the 'aromatic' ring in riboflavin is explained. Further sections include the biosynthesis of flavonoids, of lignin and of the tropolone ring as well as of oestrogens.

The author next deals with the biosynthesis of heterocyclic ring systems as in certain amino acids, nicotinic acid, DPN and TPN. This part is followed by references to Butenandt's ommochromes and to compounds such as nicotine and lysergic acid. Then follows a fairly full acount of biosynthesis in the porphyrin field.

Chapter 6 covers the biosynthesis of nucleic acids and related compounds but does not enter into problems of function. It is interesting that, unlike the biosyntheses discussed earlier, animal experiments have here been much more important than studies on micro-organisms. The isotopes ^{13}C, ^{14}C and ^{15}N have been used with great acumen in helping to ascertain which atoms in purines and pyrimidines come from the different precursor substances. The role of tetrahydro-folic acid in the formation of inosinic acid from 5-amino-4-imidazole-carboxamide ribotide is discussed and shown to be a key process. This section deals ably with processes which are complicated, rather difficult and quite important, including the biosynthesis of RNA and DNA and of riboflavin and pteridines.

The next chapter deals with the biosynthesis of terpenes and related compounds. The scheme acetate→ mevalonate → isopentenyl pyrophosphate → farnesyl pyrophosphate → squalene → lanosterol → cholesterol is explained clearly, and its implications for steroid biochemistry are well set out. There is also a tidy account of biosynthesis in the carotenoid field on which Goodwin is an authority, and the biosynthesis of ubiquinone is mentioned.

The final chapter, on regulation of cell metabolism, is in part based on a recent Ciba Foundation Symposium under the same title. Goodwin discusses the notion of feed-back in biochemistry, the control of respiration, glycolysis, biosynthesis, enzyme repression and induction, segregation of enzymes, active transport, the Pasteur effect and the function of lysosomes. In the Ciba publication (which is described as 'by experts for experts') the discussion is a superb example of minds beset by semantic difficulties but reaching out towards a unified picture of the non-hormonal regulation of cell metabolism. Goodwin has neatly summarized an untidy body of facts and speculations and to some extent he has conveyed an expectancy of a quickly emerging pattern of knowledge.

The book as a whole is a very scholarly achievement. The selection of topics represents the author's personal choice and is quite contemporary. It should make a real contribution to education at the Honours and postgraduate levels.

R. A. MORTON

THE CHEMISTRY AND BIOLOGY OF SIALIC ACIDS AND RELATED SUBSTANCES. A. Gottschalk. Pp. ix + 115. *Cambridge: University Press*, 1960. 22*s*. 6*d*.

This relatively small volume, written by one who has made many contributions to the subject, is to be welcomed; it covers in considerable detail a field of study of great interest and importance to those concerned with the biology and chemistry of mucins, the constituents of the bacterial cell wall, and the nature of the materials which competitively inhibit haemagglutination brought about by viruses, to mention only the most carefully studied systems in which the sialic acids play an important part.

After a brief historical introduction in Chapter 1, the kinds of materials which contain sialic acid and their distribution are discussed. The chemistry of sialic acids, their qualitative and quantitative determination, their colour reactions and chromatography and their mode of

linkage in natural products are considered; their function as integral parts of prosthetic groups of certain biologically active mucoproteins and mucolipids is reviewed. Finally, a short account of the enzymes which act on the linkages joining the acids to the main component of the naturally occurring macromolecules, the sialidases or neuraminidases and aldolases, is given and the closely related muramic acid is not overlooked.

It is a matter for regret that the book has no index, the absence of which restricts the use of this small volume for quick reference; many useful, new and important facts about the sialic acids which are contained in its pages will not be readily available. In such a rapidly growing field of study it is probable that a second edition will be called for, and it is to be hoped that the author and publisher will see that this omission is made good.

The book contains a few references to papers published in 1960, and it is therefore unfortunate that a description of Warren's method (published in 1959) for the quantitative determination of the sialic acids was not included; this excellent and important method is now in general use.

The book can be strongly recommended; it is well produced and modest in price. Because of the importance of the sialic acids in so many fields of study, Gottschalk's small and up-to-date volume should be read by all those engaged and interested in the carbohydrate components of biological systems.

W. T. J. MORGAN

PHENOLICS IN PLANTS IN HEALTH AND DISEASE. (Proceedings of a Plant Phenolics Group Symposium held at Bristol, April, 1959.) Edited by J. B. Pridham. Pp. ix + 131. *Oxford: Pergamon Press Ltd*, 1960. 42*s*.

The structures and properties of numerous phenolic substances isolated from plants were described more than 50 years ago, but it is only relatively recently that investigations of the biosynthesis of these compounds have been made and their possible functions considered. This book reports the proceedings of a Symposium held in April, 1959, to discuss progress in these fields, that is in the biology of phenolics. Of the 20 contributions, 17 come from research stations concerned with problems of growth and preservation of fruit and vegetable crops, where interest in the contribution of phenolics to economically desirable qualities has arisen as part of more general studies. There are four sections: general, lignification, pathology and genetics. From the viewpoint of the general reader, the book suffers from a weakness of volumes of this type in its lack of continuity and of introductory matter. Many of the authors present only short accounts of recent experimental work; notable exceptions are a short review of phenolic glycosides (J. B. Pridham) and two articles on lignification (T. Swain and F. A. Isherwood) which summarize present-day knowledge in addition to presenting new results. For the specialist there is detailed information, among other things on phenolic germination inhibitors, the distribution of phenolics in relation to botanical classification, metabolism of phenolics by fungi and genetic control of the formation of phenolics.

The book is of interest to the chemist in bringing to his notice the large variety of such compounds now known to occur in plants and their widespread occurrence, together with recent information on the progress in understanding the routes of biosynthesis.

HELEN K. PORTER

STERIC ASPECTS OF THE CHEMISTRY AND BIOCHEMISTRY OF NATURAL PRODUCTS. Biochemical Society Symposium No. 19. Edited by J. K. Grant and W. Klyne. Pp. vii + 137. *Cambridge: University Press*, 1960. Paper edition 20*s*. Cloth edition 30*s*.

The booklet under review was published last November and is made up of papers delivered at a one-day symposium held on 30 June, 1959. Since some of the contributions deal with rapidly developing subjects, such a delay in publication is somewhat unfortunate, though it was no doubt unavoidable. However, we now have a collection of seven short reviews which can be read with great interest and profit.

In the first, methods for correlating the configurations of organic compounds are summarized by W. Klyne (London) in a form which many will find useful for reference. There follows a very lucid account of the stereochemistry involved in the biosynthesis of terpenes and steroids, a subject of great topical interest to chemists and biochemists alike, by D. Arigoni (Zürich). Some steric aspects of drug action are then surveyed by R. B. Barlow (Edinburgh), and a paper by G. A. J. Pitt and R. A. Morton (Liverpool) reviews the truly remarkable part played by geometrical isomerism in the chemistry of vision. The last three contributions deal with steric factors in enzyme action; hydrolytic enzymes are discussed by E. C. Webb (Cambridge), oxidation–reduction enzymes by E. C. Slater (Amsterdam) and some enzymes of nucleotide metabolism by G. R. Barker (Manchester). The various contributions thus cover a very wide field and serve as a reminder, if any were needed, of the fundamental importance of stereochemistry to a proper understanding of the properties and functions of natural products.

It is well printed and contains very few errors.

B. C. L. WEEDON

AN INTRODUCTION TO TRANSITION-METAL CHEMISTRY: LIGAND-FIELD THEORY. L. E. Orgel. Pp. 180. *London: Methuen & Co. Ltd; New York: John Wiley & Sons Inc.*, 1960. 25*s*.

This small book is rather mistitled—it contains virtually no chemistry of the transition metals and very

little theory. It is a completely non-mathematical treatment of valence theory (excluding the valence-bond approach) applied to transition-metal ions and complexes which is 'directed to students of inorganic chemistry and to others [the flyleaf mentions 'experimental chemists and physicists who lack the training in quantum mechanics'] seeking a general impression of this rather new valency theory.' What such students will get is very little impression of the theory but an idea of the more successful results of the theoretical considerations, except for those 'topics however important which do not lend themselves to qualitative exposition.'

I am certainly in favour of encouraging students to follow the path of righteousness and acquaint themselves with modern valency theory, but I believe that the 'lack of training in quantum mechanics' is the first problem to be tackled, and students would benefit much more in the long run from more rigorous instruction in the basic mathematical approach than from having the prettier results in a limited area presented in a very diluted, palatable form. There is a danger that this book may become an examination catechism whose contents are trotted out in a barely digested, let alone understood, fashion at examination time.

Used properly, however, this volume can be very useful, and a guide to further reading, for which adequate references are given. There is no other book at present in which the very varied chemical behaviour of the d-group transition elements is summarized in short compass with 'explanations.' Apart from general aspects, the author deals with stereochemistry, reaction mechanisms, unsaturated hydrocarbon and other π-bonded complexes and low and high valencies; there is a short appendix on magnetic susceptibilities.

Even though it may be found unsatisfying in many respects—and this may stimulate students to remedy their lack of mathematics—this book can be recommended for the purpose for which it was intended. It is to be hoped, however, that the material therein will be used to supplement and not supplant the chemistry of the transition metals. G. WILKINSON

NEUERE METHODEN DER PRÄPARATIVEN ORGANISCHEN CHEMIE. BAND II. Edited by W. Foerst. Pp. 272. *Weinheim: Verlag Chemie, GmbH*, 1960. DM 14.50.

This volume contains reprints of authoritative reviews which have appeared in *Angewandte Chemie* in the period 1955–58. The subjects reviewed include: syntheses with acetoacetaldehyde (Franke, Kraft, Kosswig); preparation of peptides and ureas through reactive amides or imides (Goldschmidt and Krauss); preparation of long-chain carboxylic acids from cyclohexan-1,3-diones (Stetter); the preparative importance of cyclopentanon-2-carboxylic ester (Mayer); keten in preparative organic chemistry (Quadbeck); preparative and analytical importance of phosphines and related compounds (Horner and Hoffman); reduction of carbonyl compounds by complex hydrides (Hormann); alkylation of aromatic amines (Stroh, Ebersberger, Haberland, Hahn); chemical synthesis of intermediates of carbohydrate metabolism (Fischer); aminomethylations (Hellmann); selective catalytic oxidation with noble-metal catalysts (Heyns and Paulson); alkylation of phenols with olefins (Stroh, Seydel, Hahn); the continuous preparation of phenyl sodium (Ruschig, Fugmann and Meixner); and newer researches into oxidation with lead tetra-acetate (Criegee).

Some of these reviews are already rather out of date, but they are in general very informative, detailed, have a strong practical bias and many leading references.

A. J. BIRCH

PHYSICS AND CHEMISTRY. A UNIFIED APPROACH. BOOK I. J. C. Hogg, C. L. Bickel and E. P. Little. Pp. xi + 374. *Princeton: D. Van Nostrand Co. Inc.; London: D. Van Nostrand Co. Ltd*, 1960. 37*s*. 6*d*.

This book is the first of two designed for pupils in their last two years at American schools, where chemistry and physics are often taught as a unified science. The basic unity between these two subjects is obvious, but as the standard of the material varies from third- to sixth-form work, the book has no direct value as a text for any particular examination in this country. This is perhaps unfortunate.

The book is divided into five 'units,' each consisting of six to nine chapters. The first is devoted to elementary concepts of electricity and energy transformations. In the second chapter the point is made that arithmetic can be time-consuming, and the pupil is introduced to the use of a slide-rule. This is surely to be encouraged. The approach to the chemistry is essentially from the 'atomic viewpoint,' and the second unit deals with the structure of the atom, chemical bonds, valence and oxidation numbers, together with the chemistry of hydrogen, oxygen and water. Stoichiometric calculations are also included. The next unit deals with pressure in gases and liquids, the kinetic theory of gases and the gas laws. Then temperature and the expansion of gases, liquids and solids, heat measurement, heat from electricity, evaporation and vapour pressure, and the chemistry of carbon and carbon dioxide are discussed. The final unit is devoted to parallel forces, forces acting at a point, velocity and acceleration, accelerated motion, Newton's laws of motion, and momentum and gravitation.

Each chapter contains effective demonstrations, and has a summary of essential facts together with questions on the text and a number of problems. There is an appendix listing various physical quantities and some trigonometrical relations, and a glossary of definitions and terms. Objection might be made to some of these, *e.g.* 'deliquescence' as 'the absorption of enough water

vapour by a substance to make it sticky'; 'radical' as 'a group of atoms bound together by strong electrical forces'; and 'resonance' as 'the swinging of a valence bond from one atom to another.'

There are some other points for criticism. Thus symbols such as Zn^{+2} and CO_3^{-2} are used throughout. On p. 258, sodium carbonate and sodium bicarbonate are shown as covalent compounds. Some of the 'explanations' offered are naïve half-truths and some quite misleading, and these would have to be unlearned at a later stage, *e.g.* 'adsorption' on p. 252, and 'properties of metals' on p. 220–221. It is better to omit such considerations altogether than to give a false grounding. However, these are small points.

The volume is most attractively produced. The whole text is very clearly written, and the use of units in calculations is stressed throughout. Very effective diagrams are included and the presentation is to be highly recommended. The book should surely be in every school library. Teachers should find it a good source of ideas for presentation of material, and also for demonstrations.

C. T. GREENWOOD

A CONCISE ORGANIC CHEMISTRY. J. B. Guy and S. D. Woods. Pp. viii + 501. *London: Blackie & Son Ltd*, 1960. 27*s*. 6*d*.

This book follows the usual pattern of modern school textbooks of organic chemistry. Trivial names only are used, and modern reaction mechanisms are omitted in the formal treatment of organic compounds. Mechanisms are, however, included in a special chapter near the end of the book. This approach is justified by the separate requirements of advanced and scholarship level syllabuses.

A study of organic compounds from the chemical bond aspect gives a useful guide to many reactions and properties. This procedure is used by the authors to eliminate the old-fashioned 'memorization' method, which has been strongly condemned by G.C.E. 'A' Level examiners in recent years. The sharp distinction between volatile covalent compounds and ionic crystalline salts is clearly emphasized, although the intermediate nature of compounds containing hydrogen bonds is not discussed. The action of alcholic potash on ethyl iodide is definitely stated to be unsuitable for the preparation of ethylene. This is a welcome improvement on many recent editions of elementary organic textbooks. Fluorine compounds are included, although their classification under 'compounds derived from coal' seems inappropriate. A considerable number of commercially important products such as silicones, plastics and insecticides are included, with useful notes on their structures and properties.

The paraffins are described as inert (p. 45) without comment on the relative nature of this term. This is rather a strange description of compounds which undergo oxidation, halogenation, nitration, sulphonation, isomerization and thermal decomposition. On p. 95 sodium ethoxide is formulated: $C_2H_5{\cdot}ONa$. More correctly, it should be written: $C_2H_5O^-Na^+$. The chapter on mechanisms is concise and the authors, by careful use of the electronegativity concept, avoid the necessity of discussing rival systems of nomenclature and sign convention. The inductive and electromeric effects are, however, treated rather too briefly, and would hardly suffice for a first introduction of these topics to a student.

The price is a little higher than is usual for textbooks of similar scope, but the good appearance and layout of the book justify the additional cost.

E. J. ROTHERY

AN INTRODUCTION TO ELECTRONIC THEORY OF ORGANIC COMPOUNDS. H. L. Heys. Pp. 236. *London: George G. Harrap & Co. Ltd*, 1960. 16*s*.

This book is intended to bridge the gap between the study of theoretical organic chemistry at the elementary and at the more advanced levels, and it succeeds in that purpose. The impact of electronic theories on the understanding of organic chemistry has been very great, though such theories are not yet widely incorporated into school courses. That is why there have been, in recent years, a number of reasonably elementary books aiming to link the kind of treatment in most standard school textbooks of organic chemistry with that to be found in such authoritative works as Ingold's *Structure and Mechanism in Organic Chemistry*. The time will come, no doubt, when normal school courses of organic chemistry include much more mention of electronic theories. Already, in the United States, many introductory organic chemistry texts provide a dual presentation of theories with facts, though such texts are generally used by students older than a first-year sixth-former in this country.

This book is intended for use by a student who has already acquired a reasonable factual knowledge of simple organic compounds and reactions. It shows how modern theories can be applied to give a more detailed and broader picture, even though the theories of organic chemistry still lag far behind the facts.

The important topics discussed in the book include the distribution of electrons in atoms, the nature of the covalent bond (both from a valence-bond and a molecular orbital point of view), resonance, conjugation, acids and bases, tautomerism and free radicals. Addition, substitution, elimination and chain reactions are also considered in some detail.

The treatment is concise and clear, though the condensation necessary in a book of this kind cannot be achieved without the inclusion of some rather dogmatic statements. Moreover, some readers may well feel that certain sections are all too brief for real understanding except by a person already familiar with the ideas

involved. However, the author includes a number of references to original papers, and gives a bibliography of more detailed and larger books.

The main purpose of the book has been skilfully achieved, for any student who reads it carefully will certainly be in a better position to study more advanced books on the same subject. Some good sixth-formers, most first-year university students and many teachers will find this book very interesting and helpful.

G. I. BROWN

SINTERING SYMPOSIUM. A.I.M.M. September, 1958. Pp. vi + 381. *Melbourne: The Australasian Institute of Mining and Metallurgy*, 1960. 50*s*.

This Symposium, dealing with the preparation of sintered charges for the smelting of metalliferous ores, contains 13 papers, seven from Australian contributors, four from the U.K. and one each from the U.S.A. and Germany. The papers cover, in the words of the general summary on p. 1, 'the historical, scientific, engineering and production aspects of sintering.'

The papers which prove to be of most interest to the metallurgical chemist are those which fall into the 'scientific' category and describe, in the main, the operation and results of small-scale sintering experiments. These include papers on iron-ore sintering by Voice and Wild, dealing with fundamental factors such as specific air volume and permeability which influence sinter output, and by Bogan and Worner on the sintering of fine haematite ores; the important problem of the structure of sinters with regard to their constituent crystalline and glassy phases is also discussed.

Related to the experimental approach to problems in the production of sinter for the extraction of zinc and lead, there are papers by Manson on laboratory studies of updraught lead-sintering, by Hamdorf on factorially designed experiments to discover the factors controlling lump output, by Peucker, Massion and Wendeborn on gas recirculation and by Woods and Harris on the problems of a combined zinc–lead feed for the zinc-blast furnace, the latter containing a useful summary of the complex physical chemistry of such a sinter. A short paper by Blaskett on heat flow and movement of the combustion zone in a sinter bed should also be included in this category. Of the other papers, one concerns the history of sintering at the Port Pirie lead-smelter while the other five papers deal particularly with production and engineering aspects of sinter plants.

Question and answer sections follow each paper but, with one or two exceptions, contain little in the way of notable contributions to discussion.

This is in no sense intended to be a textbook on sintering, yet the papers presented in this Symposium will serve both as a useful introduction to the subject for the uninitiated, and also as a summary of present-day theory and practice for those extraction metallurgists more closely concerned.

The A.I.M.M. must be complimented on the high standard of printing and presentation of this volume.

A. W. RICHARDS

MINERAL USE GUIDE OR ROBERTSON'S SPIDERS' WEBS. R. H. S. Robertson. Pp. 44. *London: Cleaver-Hume Press Ltd*, 1960. 21*s*.

This volume, which consists of 32 diagrams illustrating the uses of a number of minerals and rocks, is an interesting example of 'visual aid' presentation of technical data. The name of each mineral is printed at the centre of the diagram and the uses or products are reached by concentric circles. In all, about 52 rocks and minerals (mostly non-metallic) are dealt with; however, although two diagrams are devoted to palygorskite, most of the metallic ores, borates, graphite, potassium salts, the sillimanite group and sulphur are not included.

In the Introduction it is stated that 'each diagram shows every application of a mineral known to the author,' but unfortunately the diagrams do not differentiate between the major uses and those of very minor industrial importance; in fact, one rather suspects that some of the uses have not got very far beyond the stage of being incorporated in patent specifications.

The diagrams should be useful for conveying to a school science class, or a non-technical audience, a general idea of the great diversity of uses of particular minerals, and for such purposes the diagrams are in convenient form, being strongly mounted and well-adapted for projection by an epidiascope.

S. J. JOHNSTONE

MODERN ASPECTS OF THE VITREOUS STATE. VOLUME 1. Edited by J. D. Mackenzie. Pp. viii + 226. *London: Butterworths*, 1960. 50*s*.

This book comprises eight essays on glass, which is defined as any isotropic material formed from a liquid, organic or inorganic, with an absence of three-dimensional atomic periodicity and a viscosity $>10^{14}$ poise. The emphasis is on structure and other fundamental aspects. S. Urnes discusses X-ray diffraction studies, with special reference to the network theory of Zachariesen and the crystallite theory of Randall and others. This chapter is valuable as a reassessment of earlier X-ray work in the light of more accurate modern analysis. Chapter 3 by D. Turnbull and M. H. Cohen is an excellent survey of the kinetic factors which control the crystallization of inorganic and organic glasses, with only one minor blemish, a reference to the formation of glass by S_8 (p. 38). In chapter 4, A. E. R. Westman discusses the application of polymer chemistry to phosphate glasses. His remarks on p. 88 and p. 90 are so worded as to appear to predict the well-known analogy between $AlPO_4$ and SiO_2. Rather more than five lines might have been given to N.M.R. spectra, especially as

the next chapter, by P. J. Bray and A. H. Silver, deals mainly with nuclear quadrupole effects in borate glasses. I. Simon considers in a semi-empirical and comparative fashion in chapter 6 the study of the infra-red spectra of glasses. In chapter 7, J. H. Gibbs calculates polymer partition functions by the use of a cell model and by making allowance for the restricted rotation of linear chains. The thermodynamic aspects of the glass transition are discussed in terms of Ehrenfest's definition of a second order transition. The editor has written an introduction, and in the last chapter deals with fused inorganic glasses.

On the whole, the book is stimulating, but there is a good deal of overlap, and most of the authors discuss the merits of the various rival theories, although some of the latter probably apply to different ranges of composition with silicate glasses and are not really mutually exclusive. The book can be highly recommended to anyone interested in the general aspects of the solid state, as well as to polymer chemists and glass technologists. Only one misprint was noted, gasses for glasses on p. 208.

R. S. BRADLEY

CLAYS AND CLAY MINERALS. Proceedings of the Seventh National Conference on Clays and Clay Minerals. Edited by Ada Swineford. (Monograph No. 5, Earth Science Series.) Pp. ix + 369. *London: Pergamon Press Ltd*, 1960. 60*s*.

The first National Clay Conference in the U.S.A. was held in 1952, and these conferences have since been held annually. Clay mineralogists have come to expect a high standard of papers in the Proceedings, and the present volume is no exception to the rule.

It has been the aim of the committee organizing these conferences to bring together people from a wide variety of disciplines, all of whom are interested in clays or clay minerals. The 24 papers in this volume therefore range over many topics. Nearly a third of the book is taken up by two papers dealing with the effect of saline waters on clay minerals. A further third is made up of eight papers on the regional clay mineralogy of various parts of the United States, together with two on the genesis and identification of soil clays. The remaining third, comprising 12 papers, deals principally with experimental clay mineralogy, and will probably be of greater interest to the chemically-minded reader. There are two papers on the application of X-ray diffractometry to clay minerals; these provide an authoritative and comprehensive guide to what is still a relatively new technique. Synthetic clay mineralogy is represented chiefly by a paper on the synthesis of illites, and one on the conversion of montmorillonites into chlorite-like materials. In the field of crystal structure, there is a paper on the role of the water molecules in vermiculite. There are reviews of the classification of clay minerals in the montmorillonite group, and of experimental clay mineral research in Yugoslavia. Two papers deal with the rheology of clay suspensions, and three with various aspects of chemical attack on clay minerals. This has been studied mainly as an aid in identification, or in connection with surface area determinations.

The breadth and quality of the proceedings are an indication of the vigour with which all aspects of clay mineralogy are being pursued in the United States, the more so when one realizes that similar conferences are held each year. The book is well produced, at a reasonable price. The editor, contributors and publisher can all be congratulated on their work. The volume must be considered essential reading for all who wish to keep abreast of current developments in clay and clay mineral research.

H. F. W. TAYLOR

PUBLICATIONS RECEIVED

ANNUAL REPORT OF THE SCIENTIFIC ADVISER FOR THE YEAR 1959. London County Council Public Health Department, Scientific Branch. Pp. 46. *London: London County Council*, 1960. 1*s*. 3*d*.

THE MOND PLATINUM METALS REFINERY. Pp. 31. [Modern metallurgical processes leading to the production of P.M. concentrates; refining of these concentrates; laboratory control; development and research; properties and uses of the platinum metals.] *London: The Mond Nickel Co. Ltd*, 1960.

THE DISPENSATORY OF THE UNITED STATES OF AMERICA. VOLUME II. NEW DRUG DEVELOPMENTS. 1960 Edition. A. Osol and R. Pratt *et al*. [Information on new therapeutic substances and certain drugs already described in Volume I, and general survey articles on certain categories of medicinals.] *London distributors: Pitman Medical Publishing Co. Ltd*. 72*s*. net.

BRITISH STANDARDS

572 : 1960. Specification for Interchangeable Conical Ground Glass Joints. Pp. 11. 4*s*. net.

823 : 1960. Density–Composition Tables for Aqueous Solutions of Sodium Chloride and of Calcium Chloride. Pp. 31. 8*s*. 6*d*. net.

1792 : 1960. Specification for One-Mark Volumetric Flasks. Pp. 10. 4*s*. net.

3276 : 1960. Specification for Thermometers for Measuring Air Cooling Power. Pp. 16. 5*s*. net.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY. INFORMATION BULLETIN NUMBER 12. *London: Butterworths Scientific Publications*, 1960.

Institute Affairs

ANNUAL GENERAL MEETING

The 83rd Annual General Meeting will be held at 9.30–10.30 a.m. on Friday, 21 April in the Assembly Hall, University of Southampton.

The formal notice of the meeting and other relevant papers, including the Annual Report of the Council for 1959–60, will be circulated with the March *Journal*.

Ballot papers for the election of Officers, Censors and General Members of Council will be sent to corporate members in Great Britain and Ireland under separate cover.

NEW GRADE OF MEMBERSHIP

The results of the recent *Referendum* issued in connection with the proposed new grade of membership will be considered by the Council at its meeting on Friday, 17 February.

Any Special General Meeting that may be required to deal with this question will not be called until after the Annual General Meeting and probably not before June.

Institute Representation.—The following members have been appointed to serve as representatives of the Institute in the capacities stated:

City and Guilds Institute. Dr A. J. Lindsay, *Fellow*, on an exploratory committee to report on the desirability of establishing courses and conducting examinations in radiological protection;

University of Hull. Mr R. S. Howard, *Fellow*, on the Court of the University;

British Standards Institution. Mr W. T. Elwell, *Fellow*, on Committee ISE/18—Sampling and Analysis of Iron and Steel.

Liaison Officer.—Dr E. I. Chappell, *Associate*, head of the department of chemistry and metallurgy at Chesterfield College of Technology, has been appointed Liaison Officer at the College in succession to the late Mr N. J. Booth.

Education Committee.—Dr D. Ridge, *Fellow*, formerly H.M. Inspector of Schools, has joined the Education Committee of the Institute as a co-opted member.

London Symposium on Soil Problems.—The London members of the Institute, the Institute of Biology and the Institute of Physics and the Physical Society have arranged a symposium on 'The Soil: Problems Raised by its Use and Misuse'. It will take place in the William Beveridge Hall, Senate House, London, W.C.1, at 2.30 p.m. on 15 March. The speakers are Sir E. John Russell, O.B.E., F.R.S., E. Crompton (School of Agriculture, University of Durham), Drs H. L. Penman, G. W. Cooke and K. Mellanby, M.B.E. (Rothamsted Experimental Station), Dr S. D. Garrett (Botany School, University of Cambridge) and G. V. Jacks (Commonwealth Bureau of Soil Science). There is a registration fee of 5*s*., which will cover tea and synopses of the papers to be given. Application by members of the Institute should be made to the Assistant Secretary, Royal Institute of Chemistry, 30 Russell Square, London, W.C.1.

It is intended to publish a full report of the proceedings in due course, under the editorship of Dr Mellanby.

Birmingham Spring Course.—The Birmingham and Midlands Section has arranged for its Spring Lecture Course, on Electrochemistry, to take place on Saturday mornings in March. The course will be held in the Byng Kenrick Suite, College of Advanced Technology, Gosta Green, Birmingham. The programme will be as follows:

4 March.	Electrolyte Solutions. Dr J. E. Prue
	Electrode Reactions. Dr J. E. B. Randles
11 March.	Anodic Processes. Dr H. R. Thirsk
	Protection and Corrosion of Metals. Dr T. P. Hoar
18 March.	Polarography in Analysis. Dr G. W. C. Milner
	Electrometric Titrations. Dr J. P. G. Farr
25 March.	Deposition of Metals. Dr F. W. Salt
	Some Aspects of Industrial Electroplating. Mr U. F. Marx.

Registration forms and further particulars may be obtained from Dr J. E. Gregory, Hon. Secretary, Birmingham and Midlands Section R.I.C., c/o The College of Advanced Technology, Gosta Green, Birmingham, 4.

Royal Automobile Club Group Scheme.—Corporate and Graduate Members of the Institute are reminded that a group scheme exists for associate membership of the Royal Automobile Club. Members of the group receive all the benefits available to individual members of the Club, including road services, legal aid, assistance with tours and technical advice.

The standard annual subscription rate of £2 2*s*. is reduced to £1 11*s*. 6*d*. for group members; in order to reduce administrative costs for the scheme it is a condition of group membership that subscriptions are paid annually, in advance, by bankers order.

Corporate and Graduate members of the Institute may join the group at any time; members of the Club who wish to transfer to the group are asked to apply for

group membership when their current annual subscription to the Club expires. Further details of the services may be obtained from the group secretary, Mr J. F. Harding, at 30 Russell Square.

Lectures, Monographs and Reports.—The distribution of Nos 3, 4 and 5 was completed early last month. Owing to an error in collation, plates I and II were omitted from most copies of No. 4, *i.e. Chemistry in Everyday Life: The Contribution of the D.S.I.R.*, by Sir Harry Melville.

As the next distribution will not be made for about three months, members requiring the plates are requested to write direct to W. Heffer & Sons Ltd, Hills Road, Cambridge.

Members and subscribers are reminded of the special arrangements for the binding in grey cloth of *L.M. & R.* for 1959-60 in one volume, price 11*s.* 6*d.* including return postage. All inquiries and matter for binding should be addressed to W. Heffer & Sons Ltd as above.

Lecture Series 1961.—The Council has authorized the shortening of the title of the series *Lectures, Monographs and Reports* to *Lecture Series*. This, it is thought, more accurately reflects the type of material included, though it is proposed to continue to include review-type material and surveys of matters of wide interest. At the same time a new two-colour cover will be introduced.

It is the intention to inaugurate the new series with three special contributions:

No. 1. *Atmospheric Photochemistry*, by Sir Harrie Massey, of University College, London, and Dr A. E. Potter, head of the Reaction Kinetics Section, National Aeronautics and Space Administration, Cleveland, Ohio.

No. 2. *A Chemist's Introduction to Statistics, Theory of Error and Design of Experiment*, by Dr D. A. Pantony, of the Imperial College of Science and Technology, London.

No. 3. *Recent Developments in Polarography*, by Dr G. W. C. Milner, A.E.R.E., Harwell.

Chemical Society Library.—All members, both corporate and non-corporate, are reminded that they have full borrowing rights from the Chemical Society Library, Burlington House, Piccadilly, London, W.1. Inquiries about books, journals, photocopies and the like, and all bibliographical inquiries should be addressed to the Librarian. Other inquiries should be addressed to the Assistant Secretary (Scientific), 30 Russell Square, London, W.C.1.

'The Times': Reduced Rate for Students.—Students at university, technical college and school are reminded that they can obtain *The Times* at the reduced rate of 2½*d.* a copy. Registration forms and full particulars can be obtained from The Subscription Manager, *The Times*, Printing House Square, London, E.C.4.

PERSONAL NOTES

News of Hon. Fellow

Sir John Cockcroft, O.M., *Nobel Laureate*, has been awarded the 1961 Atoms for Peace Award, to be presented at the Massachusetts Institute of Technology on 6 April.

Honours and Awards

Sir Charles Dodds, M.V.O., F.R.S., *Fellow*, Courtauld Professor of Biochemistry, University of London, has been elected to honorary life-membership of the New York Academy of Sciences.

Professor F. H. Garner, O.B.E., *Fellow*, has been awarded the Honorary Fellowship of the Institute of Petroleum.

Professor Sir Cyril Hinshelwood, O.M., F.R.S., *Nobel Laureate, Fellow*, has been awarded the Society of Chemical Industry's Medal for 1961. He will receive it at Oxford in July. The Medal is presented every two years for conspicuous services to applied chemistry by research, discovery, invention or improvement.

Sir Eric Rideal, M.B.E., F.R.S., *Fellow*, will have the honorary degree of D.Sc. conferred upon him at the Queen's University of Belfast in July.

Dr W. A. Sexton, *Fellow*, has been awarded the degree of Doctor of Science by the University of Liverpool.

Liverpool College of Technology.—The Governing Body of the City of Liverpool College of Technology has announced that Mr E. LeQ. Herbert, *President*, and Mr F. W. Adams, *Fellow*, are among those who have accepted invitations to become Honorary Associates of the College.

Societies and Institutions

Mr M. Lovett, O.B.E., *Fellow*, will be installed as President of the Institute of Sewage Purification at the annual conference to be held in Brighton in June. Mr Lovett is chief inspector of rivers of the Yorkshire Ouse River Board.

Consultants

Dr L. A. Allen, *Fellow*, who was until recently in charge of the molasses utilization department at the Tate & Lyle Research Laboratories, is now in practice as an independent consultant microbiologist and chemist, specializing in research and development work, hygiene, effluents and problems in the food and fermentation industries. His address is 66 Sutherland Avenue, Petts Wood, Orpington, Kent. Tele: Orpington 26291.

Mr T. E. Rymer, *Fellow*, has been appointed Public Analyst and Agricultural Analyst for the counties of East and West Sussex and the county boroughs of Brighton, Eastbourne, Hastings, Hove and Worthing. He is joining Mr J. Redman, *Fellow*, in the analytical

and consulting practice of Rymer and Redman (formerly Wright and Redman), of 1 Offham Road, Lewes, Sussex.

Educational

Dr S. Basu, *Fellow*, of the department of chemistry, University College of Science and Technology, Calcutta, is now a visiting Associate Professor in chemistry at the University of Indiana.

Dr R. D. Batt, *Fellow*, has recently been appointed Associate Professor of Biochemistry, Otago Medical School.

Dr C. J. L. Booker, *Associate*, of the department of metallurgy, University of Cambridge, has taken up a research fellowship at the division of applied chemistry, National Research Council, Ottawa.

Dr D. J. Daniels, *Associate*, has taken up a post as lecturer in organic chemistry, Norwich City College and Art School. He was formerly chemistry master at High Pavement Grammar School, Nottingham.

Mr A. C. Darby, *Associate*, is now at the department of chemistry, West Ham College of Technology.

Dr R. S. Edmundson, *Associate*, is now lecturer in organic chemistry, Institute of Technology, Bradford. He was formerly a research chemist with Fisons Pest Control Ltd.

Mr B. Hudson, *Associate*, has left the Adamura Provincial Secondary School, Yola, Northern Nigeria, to teach chemistry at the Government College, Keffi, Northern Nigeria.

Dr W. J. Hughes, *Associate*, formerly lecturer in chemistry, Llandaff Technical College, Cardiff, is now lecturer in education, department of education, University of Liverpool.

Dr J. Leicester, *Fellow*, has been appointed principal of the Northern Polytechnic. He is at present head of the department of applied chemistry, Northampton College of Advanced Technology, London.

Dr T. M. Oza, *Fellow*, has been appointed principal of the D.K.V. Arts and Science College, Jamnagar, Sourashtra, India.

Mr J. R. Rosindale, *Associate*, has been appointed senior science master, Queen Elizabeth Grammar School, Atherstone, Warwickshire. He was formerly at the College of Technology, Hull.

Dr P. P. G. L. Siriwardene, *Fellow*, lecturer in the department of chemistry, University of Ceylon, has been awarded a fellowship by the International Atomic Energy Authority.

Public and Industrial

Mr M. A. L. Banks, *Fellow*, has been appointed a member of the Minister of Power's Advisory Council on Research and Development.

Mr A. D. Baynes-Cope, *Associate*, has been appointed principal scientific officer, research laboratory, British Museum.

Mr T. W. Brandon, *Fellow*, has been appointed chief chemist and bacteriologist to the Sheffield Corporation. He was formerly with the Hull Corporation Water Department.

Dr J. Brown, *Associate*, is now a technical officer with the heavy organic chemicals division, Imperial Chemical Industries Ltd, Billingham, having relinquished his appointment with the British Coke Research Association.

Mr H. Buchwald, *Associate*, has accepted a post as chemist with the occupational hygiene team, Slough Industrial Health Service. He was formerly lecturer in chemistry, Whitehaven College of Further Education.

Mr V. S. Bulley, *Graduate Member*, has been appointed assistant analyst, City Analyst's Department, Leicester. He was formerly with the National Coal Board.

Mr M. S. Carrie, *Fellow*, of the Canterbury Frozen Meat Co. Ltd, is now chairman of the management committee of the New Zealand Leather and Shoe Research Association.

Dr J. Chatt, *Fellow*, has been appointed group manager, heavy organic chemicals division, Imperial Chemical Industries Ltd, consequent upon changes in the administration of the Akers Research Laboratory. He will continue in charge of the inorganic chemistry department, whose work will now be the responsibility of that division.

Mr D. G. Coursey, *Associate*, has taken up the post of principal research officer, Federal Institute of Industrial Research, Nigeria. He was formerly with the West African Stored Products Research Unit.

Mr G. Davidson, *Fellow*, has been assigned to East Pakistan by the International Labour Office, and not to Central America as previously stated (*J.*, 1960, 336).

Mr E. G. Depper, *Associate*, has been seconded to Glaxo Laboratories (India) Private Ltd, Bombay, for an indefinite period. He was formerly at Ulverston.

Mr J. P. Elder, *Associate*, has taken up an appointment as investigator in the electrodeposition department of the British Non-Ferrous Metals Research Association.

Mr W. Flavell, *Associate*, has been appointed a director of Yarsley Research Laboratories Ltd.

Mr A. J. Harrison, *Associate*, has been appointed senior assistant analyst, Public Analyst's Department, City of Portsmouth. He was formerly assistant analyst, Public Analyst's Department, Burnley Corporation.

Mr G. C. Ives, *Associate*, has been appointed a director of Yarsley Research Laboratories Ltd.

Mr A. W. Jackson, *Associate*, formerly shop manager, fast reactor chemical plant, U.K.A.E.A., Dounreay Experimental Reactor Establishment, has been appointed manufacturing manager, Italy, of Beecham Overseas Ltd, and has gone to Milan.

Mr C. Kennedy, *Associate*, left the National Coal Board in June, 1960, and is now employed as a fuel technologist in the fuel supplies branch of the operations department, Central Electricity Generating Board.

Mr W. R. Loftus, *Associate*, formerly of the Archie's Creek Dairy Produce Co., has taken up an appointment with the Victoria State Laboratories, department of health.

Mr R. G. Mason, *Associate*, a director of A. Boake Roberts & Co. Ltd, has been appointed to the board of its parent company, A. Boake Roberts & Co. (Holdings) Ltd.

Mr N. P. Newton, *Fellow*, recently resigned his position on the board of Smith & Nephew Pharmaceuticals Ltd to take up the post of general manager, Lederle Laboratories Division, Cyanamid of Great Britain Ltd.

Mr J. W. Oswald, *Fellow*, chief chemist, Fescol Ltd, has been appointed a special director of the company.

Dr W. B. Peutherer, *Fellow*, formerly general manager of B.P. Refinery (Grangemouth) Ltd, has been appointed general manager of Scottish Oils Ltd.

Dr C. R. Redpath, *Associate*, is now a technical officer with Imperial Chemical Industries Ltd, Billingham Division.

Mr W. W. Reid, *Fellow*, is leaving England to take up the appointment of chief scientist, W. D. & H. O. Wills (Aust) Ltd, in Sydney.

Dr R. A. Robinson, *Fellow*, reader in chemistry at the University of New England, Armidale, New South Wales, moved to the National Bureau of Standards, Washington, U.S.A., early this month.

Mr K. W. Russell, *Associate*, has been appointed pilot plant manager, Forestal Co., Widnes. He was formerly a chemist with the pilot-scale department of May & Baker Ltd, Dagenham.

Mr D. E. Seymour, *Fellow*, managing director of Smith & Nephew Research Ltd, has been appointed to the board of the parent company, Smith & Nephew Associated Companies Ltd.

Dr H. A. Shah, *Fellow*, is now director (chemicals), Office of the Development Commissioner (Small Scale Industries), Ministry of Commerce and Industry, Government of India, New Delhi.

Mr A. O. Shobo, *Associate*, has joined Lever Brothers (Nigeria) Ltd as an assistant production manager.

Mr W. T. Spragg, *Fellow*, has accepted an invitation from the Iraq Government to serve as director of the Iraq Atomic Energy Commission Research Centre, and has been granted two years' leave of absence from the U.K.A.E.A.

Dr L. H. Stein, *Associate*, chief research officer, research department, African Explosives and Chemical Industries Ltd, Transvaal, has been appointed production manager, explosives, at the Modderfontein Dynamite Factory, Transvaal.

Mr R. L. Stephens, *Fellow*, recently joined Charles Bedeman Ltd, London, manufacturing chemists, as a director and chief chemist.

Dr P. H. Sykes, *Fellow*, director of research and development of the Reed Paper Group, has been appointed deputy managing director of Albert E. Reed & Co. Ltd.

Dr R. O. Symcox, *Associate*, has returned from the U.S.A., where he was a research chemist with the Monsanto Chemical Co., to take up an appointment with Monsanto Chemicals Ltd, Newport, Monmouthshire.

Mr J. A. Thomson, *Associate*, formerly lecturer in applied chemistry at Rutherford College of Technology, Newcastle, has joined the works experimental department of Imperial Chemical Industries Ltd, Dyestuffs Division, at Grangemouth.

Mr R. G. Toms, *Fellow*, chief inspector for pollution prevention and fisheries, Nene River Board, has been appointed protection of water officer to the Lee Conservancy Catchment Board.

Mr L. W. Turner, *Associate*, has joined the board of Yarsley Testing Laboratories Ltd.

Dr E. M. Vyner, *Fellow*, has been appointed director of research to the recently-formed company of Leiner-De Mulder Ltd, Doncaster.

Mr T. W. B. Waugh, *Associate*, has joined Foster Wheeler Ltd as a commissioning engineer. He was formerly with the Shell Refining Co. Ltd.

Dr I. S. Wilson, *Associate*, has been appointed senior scientist, Monsanto Chemicals Ltd, and will be free to devote his time to research on effluent treatment and the microbiological breakdown of organic compounds.

Mr F. P. W. Winteringham, *Fellow*, has been engaged as a consultant to the World Health Organization, and is now working in Geneva. He expects to return to the Pest Infestation Laboratory, Agricultural Research Council, in 1962.

Education for Management.—The composition of the Advisory Council on Education for Management was announced by the Minister of Education on 3 February. It includes the following *Fellows*: Mr E. LeQ. Herbert, *President* (representing the Institute), Dr E. G. Edwards (Committee of Principals of Colleges of Advanced Technology), Dr H. B. Nisbet (Scottish Central Institutions) and Dr F. P. R. Venables (Committee of Principals of Colleges of Advanced Technology).

LONDON PUBLIC LECTURES

The second Public Lecture arranged by the London Section, entitled 'The Story of Soap and the Growth of Modern Synthetic Detergents,' will be given by Dr K. G. A. Pankhurst at Hendon Technical College on 29 March, at 7.30 p.m.

These Public Lectures are intended to inform non-scientists of the contributions which chemistry makes to daily life. They are necessarily of a popular nature, and will interest audiences of local residents, students and qualified scientists, who will not require a scientific background to appreciate them.

Section Activities

Aberdeen and North of Scotland

Rocket Propulsion. The third meeting of the session was held on 14 December, when Dr C. H. Johnson, C.B.E., of Waltham Abbey, gave a talk on 'Rocket Propulsion.' He introduced the subject by giving a short history of rockets, especially those used in war. The work begun by Congreve led, by way of the introduction of liquid propellents by the Germans in the 1930's, to the V2 of the last war and finally to the American and Russian atomic-warhead rockets and space probes.

The lecturer next considered the design of rockets and combustion chambers and the flow of gases through the nozzles of rocket engines, and derived an equation for the velocity of the exhaust gases. The exhaust velocity depends on two terms, one related to the constitution of the exhaust gases, including the molecular weight of the constituents, and the other to the nozzle dimensions. The jet energy also depends on the difference in the pressure between the inside of the combustion chamber and that at the exit plane of the nozzle. For greatest efficiency, the rocket reaction must be highly exothermic and the fuels and oxidants must be formed from the elements of lowest atomic weight. Practical considerations of weight and fuel volume limit the possible reactants to liquids or solids, but questions of the stability of the reactants themselves or their products of combustion again cut down the number of possibilities.

Dr Johnson then discussed the properties and usefulness of several fuels and oxidants. After considering the derivation of specific impulse and the values of this for different propellents, he showed some burning patterns for solid-fuel motors. Finally he mentioned the capacity of rockets and some burn-out velocities and emphasized the advantages of composite rockets. He ended the lecture with a brief summary of the possibilities of rockets in the future, and showed how far we are from attaining inter-stellar travel.

The meeting closed with the vote of thanks proposed by Dr B. J. Aylett.

Christmas Lectures. The annual Christmas Lectures for Secondary School Pupils were held on 22 and 23 December in the chemistry department of the University, Old Aberdeen. Dr H. A. Robertson took the Chair for the first lecture, given by Mr R. E. Craig, of the Marine Biology Laboratories, Aberdeen, on 'The Ocean as a Background to Life.' Mr Craig showed how the mixing of river and sea waters, the shape of the ocean bed and the coasts and the heat of the sun all combine to produce the ocean currents. These in turn influence the plankton which drifts with the tides and the higher animals which live on the plankton.

The second lecture was given by Dr J. H. Fraser, who spoke on 'Life in the Ocean'; Dr J. A. Lovern was in the Chair. Dr Fraser's talk was illustrated by a large number of slides showing the ocean inhabitants about which he was speaking. He showed how they are all interdependent, and gave a number of instances of how the water or the physical make-up of the sea-bed sand influence the lives of the smaller ocean creatures. The lecture closed with a showing of the colour film 'Between the Tides.'

The votes of thanks were proposed by Miss E. Miller, of Albyn School, and Mr T. Bowden, of Robert Gordon's College, respectively.

Belfast and District

Hydrolytic Enzymes. A meeting of the Section was held on 13 December in Queen's University under the Chairmanship of Professor C. Kemball. Dr D. T. Elmore, lecturer in biochemistry in the University, read a paper entitled 'Catalytic Mechanisms of Hydrolytic Enzymes.'

Dr Elmore began by saying that there are several approaches to the elucidation of catalytic mechanisms of enzymes. The first comprises structural studies on the enzyme, including determination of amino-acid sequences and studies of the effects of structural modifications on catalytic properties. Secondly, information concerning the nature of participating groups at the active centre and the geometry of enzyme–substrate interaction may be provided by kinetic studies. Thirdly, on the basis of the foregoing methods, suitable models of the active centre may be devised, and their catalytic properties studied. The first two approaches formed the subject of this lecture, and were illustrated by reference to trypsin and chymotrypsin.

There is considerable evidence that the imidazole ring of a histidine residue and the hydroxyl group of a serine residue are present at the active centre of both enzymes. Methionine has also been implicated in the case of chymotrypsin. Acylated enzymes are formed as intermediates, and the hydrolysis of these is often rate-determining. The variation of V_{max} and K_M with pH enables the pK'_a values of participating groups to be determined, although results should be viewed with caution, since the values obtained may be apparent rather than real.

Substrate specificity and stereospecificity give valuable indications of the geometry of the catalytic process. Although chymotrypsin has been more widely studied hitherto, results are now accumulating for new substrates of trypsin, including the methyl esters of N^{α}-toluene-*p*-sulphonyl-L-homoarginine (THAME) and -L-ornithine.

Cholate ion activates the tryptic hydrolysis of N^{α}-toluene-*p*-sulphonyl-L-arginine methyl ester (TAME) and THAME. The thrombin-catalysed hydrolysis of TAME is likewise accelerated. It is possible that bile

salts are as important in the digestion of proteins as they are in the absorption of fat. Elevated levels of serum bile salts in cholesterolaemia may afford a link between the latter and the incidence of thrombosis.

Several mechanisms have been elaborated for the reactions catalysed by chymotrypsin and trypsin. Probably all are too naïve, and the more sophisticated approach outlined by Koshland (*Advanc. Enzymol.*, 1960, **22**, 45) is indicated. There is no evidence so far, however, that an explanation of enzyme catalysis will require any more than an extrapolation of existing knowledge of organic chemical reactions.

After Dr Elmore had answered a number of questions Mr K. L. Robinson proposed the vote of thanks.

Annual Lecture for Schools. On 2 January the Section held its annual lecture and demonstration for schools, at Queen's University. About 400 senior pupils from grammar and technical schools attended to hear Dr T. V. Arden, chief development chemist, Permutit Co. Ltd, speak on 'Some Uses of Ion Exchange.' Professor C. L. Wilson presided.

Dr Arden began by tracing the historical development of the subject. He then explained the many uses of ion-exchange resins in medicine, industry and the laboratory, illustrating how they worked by very successful and colourful bench demonstrations. A new colour film, 'Ion Exchange Resins,' was then shown.

Professor Wilson thanked Dr Arden for a lecture which gave the students an account outside the range of the normal textbook.

BRISTOL AND DISTRICT

Annual General Meeting. The first November A.G.M. following the resolution passed at the Extraordinary General Meeting held on 12 November, 1959, took place on 10 November, 1960. The following members were elected officers and members of committee: Chairman, Dr D. Woodcock; Hon. Treasurer, Dr E. J. Skerrett; Hon. Secretary, Mr J. H. Weber; Members of Committee, Dr R. B. Williams and Messrs P. J. Ballinger, B. H. Cossham, F. W. Hares, B. W. E. Minifie, E. Minshall, D. V. Richmond and D. J. Taylor. Mr I. Dembrey and Dr W. J. Williams were elected Hon. Auditors. The business meeting was followed by the interesting film, 'This is the B.B.C.'

Dinner and Dance. The Dinner and Dance held on 25 November proved to be the most successful yet. The occasion was honoured by the presence of the President and Mrs Herbert, and the Senior Common Room of the College of Science and Technology provided an excellent setting (*see* photograph).

Much credit is due to the Sub-Committee for their success in making the evening an enjoyable one by organizing not only the varied dancing programme but also the concurrent competition based on general knowledge and observation.

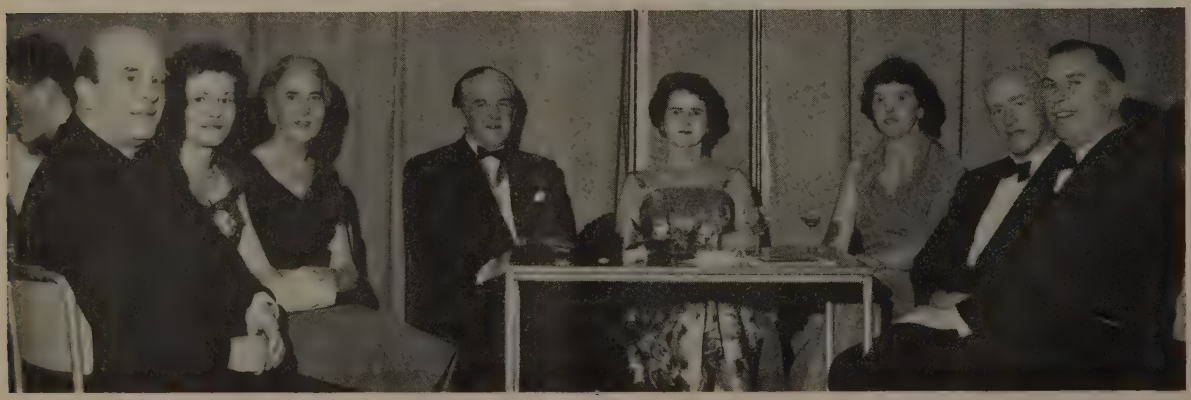
Trout Hatcheries. As a corollary to the Summer visit to the Bristol Waterworks and Trout Hatcheries a small party was privileged to see the actual spawning on 3 December.

Section Programme. The Section programme has been included in a Calendar of Meetings and Conferences of Professional Associations produced by the Bristol and Bath Productivity Association and which includes local programmes of a score of Associations. It is hoped by this means to avoid clashing dates, to attract non-members to meetings and to provide members with notice of other meetings of interest.

Analysis of Plastics. A joint lecture with the Society for Analytical Chemistry was given by Dr J. Haslam at the University of Bristol on 12 January. Dr D. Woodcock was in the Chair.

Dr Haslam began by showing the variety of problems with which the plastics chemist is confronted. The

Left to right: Dr R. W. Bolland (Member of Council) and Mrs Bolland; Mrs Moore; The President and Mrs Herbert; Mrs Woodcock; Mr G. H. Moore (retiring Member of Committee) and Dr D. Woodcock (Section Chairman and Member of Council)



analyst has a certain amount of literature to which he can refer on such topics as infra-red spectroscopy, chemistry of monomers and polymers, surface-active agents and antioxidants, but the onus is still on him to devise his own techniques to suit his particular purpose. Simple tests are still valuable, such as refractive indices, specific gravities, heating, burning, solubility in different solvents and the detection of the elements.

The lecturer demonstrated the apparatus for detecting elements, namely, the oxygen combustion flask, and emphasized the need for better methods for examining the products of combustion. Most of the tests were straight-forward colorimetric ones, and were of considerable interest.

Possible contamination from plastic containers was discussed in relation to olive oil, sodium carbonate, hydrochloric acid, alcohol and water; methods for determining trace elements by titration of organometallic complexes, flame photometry and polarography were dealt with.

Finally, the analysis of particular plastics was illustrated by reference to the various nylons, polymethylmethacrylate, polyvinyl chloride, polythene and Terylene.

After questions and discussions, the vote of thanks was proposed by Dr Stephens of the Society for Analytical Chemistry.

DUNDEE AND DISTRICT

Christmas Lecture for Schoolchildren. On 14 December at Queen's College, Mr A. W. Fairgrieve, area chemist, British Railways, Doncaster, gave the Annual Christmas Lecture for Schoolchildren on 'The Work of the Railway Chemist.' Mr J. Wylie was in the Chair.

Mr Fairgrieve traced the history of the railway chemist from 1864, when the first laboratory was opened at Crewe, to the present day. There are now nine Regional Laboratories, which have specialist laboratories dealing with paints, textiles, corrosion and building materials.

The lecturer touched briefly on the routine side of the chemist's work; nearly everything purchased by the railways is subjected to analysis or physical testing. He dwelt more fully on paints, illustrating his talk with lantern slides showing apparatus used to make a rapid assessment of the qualities of paint, as well as long-term weathering tests.

He then gave some examples of the type of problem the chemist may be asked to solve, such as the failure of motor vehicles, traced to blockage of the petrol filter by asbestos fibres from a defective washer in the petrol pump, and damage to land and drains from leaching of acid by rain from a dump of sodium bisulphate.

Mr Fairgrieve also pointed out the necessity of having some wide knowledge of other sciences, and contacts with other research organizations which may assist in solving a problem. He illustrated these points by reference to the rate of sprouting and growth of seed peas alleged wetted in transit, and the identification of roots from an Australian tree by the Royal Botanic Gardens, Kew, which proved that substitution of sand for hides had taken place in Australia and not in this country.

He also mentioned the care required in keeping railway warehouses free from insect pests, and showed lantern slides of some of the insects.

The vote of thanks was proposed by James Davidson, of the High School, Dundee.

EAST ANGLIA

Cooking, Bakery and Confectionery. A meeting was held in Norwich on 17 November, when Dr D. W. Kent-Jones gave a lecture on 'Cooking, Bakery and Confectionery.' The speaker described some of the pitfalls the housewife has to avoid in the cooking of various foods, and outlined the conditions necessary for making bread and cakes of good quality.

Considerable discussion followed the lecture. The Chairman of the Section, Mr H. F. Bamford, presided, and the vote of thanks was expressed by Mr N. Jones.

Chemical Analysis. A lecture entitled 'Instrumental Methods of Chemical Analysis' was given in Ipswich on 15 December by Mr G. F. Reynolds, of the Chemical Inspectorate, Ministry of Aviation. The lecturer, by a careful selection of examples, gave a concise account of the wide range of applications of instruments in analysis. The apparatus considered ranged from items suitable for a small laboratory with a limited budget to those of interest only to very large undertakings.

Mr Reynolds then answered several queries. Mr Bamford was in the Chair, and the vote of thanks was proposed by Mr W. C. Hanson.

HULL AND DISTRICT

Role of Cytochrome-c. On 5 December a Joint Meeting was held with the Hull Section of the Oil and Colour Chemists' Association and the Society of Chemical Industry (Oil and Fats Group) at the Royal Station Hotel, Hull.

Dr A. Banks, of the Department of Scientific and Industrial Research, Torry Research Station, Aberdeen, gave a paper on the 'Role of Cytochrome-c in the Autoxidation of Unsaturated Fatty Acids.' He reported that it is well established that haematin protein compounds such as haemoglobin, myoglobin, cytochrome-c and so on catalyse the autoxidation of fats; they play a very important part in the development of oxidative rancidity during the preservation of foods, *e.g.* during the cold storage of frozen herrings. Most of the practical problems of storing frozen herrings have now been solved, but certain features of the reactions between linoleic acid and cytochrome-c have been difficult to explain.

By studying the effect of cytochrome-c on suspensions of linoleic acid completely free from hydroperoxides, it is possible to show that cytochrome-c has an anti-oxygenic effect, in so far as an increase in the concentration of cytochrome above $1{\cdot}75 \times 10^{-5}$M will cause induction periods which become longer as the concentration of cytochrome increases. The ultimate rate of oxidation after termination of the induction period is roughly proportional to the initial concentration of cytochrome. By following changes in the cytochrome spectroscopically, it is possible to show that the concentration changes little during the induction period, but falls to zero during the very early stages of subsequent oxidation.

It has also been observed that cytochrome-c catalyses the breakdown of pure *trans-trans* methyl linoleate hydroperoxide in an atmosphere of nitrogen. Gaseous oxygen is not produced, but the fall in peroxide is accompanied by a corresponding fall in conjugated diene unsaturation. The reaction goes on equally well in the presence of added methyl linoleate. During catalysis, the cytochrome is broken down into insoluble material, which has not yet been identified. Free haematin has proved inactive under the conditions employed.

This evidence is taken to show that cytochrome-c does not catalyse the oxidation of linoleic acid, but on the contrary, that it will inhibit oxidation by breaking down the hydroperoxide into inactive components, and that the catalytic effect observed after termination of the induction period is due to a changed form of the cytochrome. The hydroperoxide appears to be broken down under the conditions so far tried into a mixture of unsaturated ketones and hydroxy epoxy acids.

The work described in the paper was carried out as part of the programme of the D.S.I.R.

The vote of thanks was proposed by Mr G. C. Green.

LIVERPOOL AND NORTH-WESTERN

Ladies' Evening. The second Ladies' Evening held by the Section on 3 November was a most successful function. Nearly 100 sixth-form pupils from local girls' grammar schools were also present.

It was held in the main lecture hall of the Liverpool College of Technology and was devoted to theoretical and practical aspects of hair condition and beauty.

Mr E. Myer, Chairman, began the meeting by introducing the principal speaker, Mr J. B. Wilkinson, research manager of the toilet preparations development unit, Unilever Ltd. Mr Wilkinson gave a fascinating and witty account of the nature and structure of hair and the contributions made by the chemist to the problem of improving its condition and beauty. Particular attention was paid to shampooing and tinting. The lecture was designed to appeal to chemists and unqualified persons alike.

After an interval for buffet refreshments, the audience reassembled to witness a series of practical demonstrations of modern hairdressing techniques conducted by Mr H. L. Frowde, of Unilever Ltd, assisted by Mrs M. J. Roberts. In these demonstrations, lady students of Liverpool College of Technology and the Central College of Further Education, Carlett Park, acted as models. Modern techniques for shampooing, setting, conditioning and tinting were demonstrated.

Miss W. M. Stewart then gave an illustrated talk on the theory and practice of hair styling. Using a set of large diagrams and herself as a model, she demonstrated the principles governing the choice of a hair style.

After an interesting session in which Mr Wilkinson and his colleagues answered a variety of questions, the meeting ended with the vote of thanks proposed by the past Chairman of the Section, Dr Helena Bradbury (whose hair had also been styled by the visiting demonstrators), and presentations to Mrs Roberts, Miss Stewart and the lady models.

The meeting could not have been held without a great deal of assistance from the management of the research departments of Unilever Ltd at Isleworth and Port Sunlight, and the Section records its gratitude to the company.

Polymer Chemistry. A meeting of the Section was held on 8 December at the Widnes College of Further Education. Mr E. Myer, Chairman, introduced the speaker, Dr A. M. North, lecturer in the department of physical chemistry, University of Liverpool.

The address was entitled 'Some Recent Advances in Polymer Chemistry.' Dr North said that considerable research effort is at present being devoted to the synthesis and study of high polymers which have unusual thermal stability or unusual electrical properties.

Thermally stable polymers can be classified as: (*a*) fluorinated polymers; (*b*) polymers with a conventional organic backbone, but with inorganic side groups (these side groups may be substituents in a conventional side group, such as the benzene nucleus, or they may be attached directly to the backbone, which functions as a polymeric ligand); (*c*) polymers with a backbone consisting in part or wholly of inorganic elements (those with a partly inorganic main chain are prepared by complexing metallic ions with bis-bidentate ligands; the purely inorganic polymers include compounds such as siloxanes, poly-aluminoxanes and a large number of polymers based upon the elements of groups III and V of the Periodic Table).

Polymers which are conjugated along the main chain and metal complexes of these poly-enes exhibit interesting properties as electrical conductors. They are being studied by conductivity and electron-spin resonance measurements.

The vote of thanks to Dr North was proposed by Dr D. Benson.

LONDON

Non-Aqueous Solvent Systems. Mr P. A. Raine took the Chair at a meeting held at Brunel College of Technology on 3 November. He introduced Dr C. C. Addison who gave a lecture on this subject which has already been reported in the *Journal* (*J.*, 1960, 187). A vote of thanks was proposed by Mr E. M. Willshaft.

Annual General Meeting. On 15 November, after the formal business was concluded, there was a general discussion on ways in which more members could be induced to take part in Section activities. Statistics indicated that members noting or replying to questionnaires rarely exceeded 10 per cent of the membership. The retiring Chairman, Mr F. C. Hymas, ended the meeting with a review of the history of the Section for the last 20 years or so.

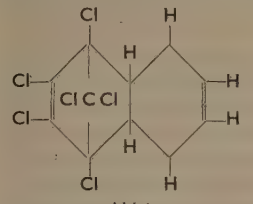
Chemical Aids to Crop Protection. A Joint Meeting with the Dartford and District Branch of the Pharmaceutical Society was held at the North-West Kent College of Technology, Dartford, on 28 November. The Chair was taken by Mr J. R. Barr, who introduced the speaker, Mr G. L. Baldit, of Plant Protection Ltd.

Mr Baldit opened his lecture by referring briefly to the history of protection of plants from insects, fungus diseases and weeds. The use of copper salts had been known for centuries, but up to 1939 the number of substances used as fungicides, insecticides and herbicides was small, and many of these were natural products, such as nicotine and pyrethrum. The most important pesticides in use were sulphur, 'lime sulphur' and Bordeaux mixture for fungi, lead arsenate, nicotine, pyrethrum, derris and petroleum and tar oils for insects, and chlorate, phenols and arsenites for weeds. Sulphur is still used in large quantities today, in addition to the newer fungicides. The herbicides mentioned were all non-selective, and none of the insecticides was really effective against red spider.

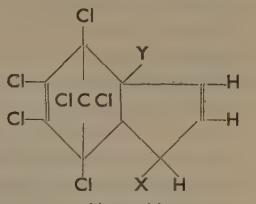
The enforced increase of food production during the war stepped up the search for new and better pesticides. Probably the first synthetic insecticide produced was DDT, which was very effective when used correctly. Use of too small a dose, however, produced conditions leading to the emergence of strains of insects resistant to DDT. A similar problem may arise with other pesticides.

Further research on organochlorine compounds during the last war led to the discovery of the insecticidal properties of benzene hexachloride. The compound exists in five isomeric states, the γ-isomer being the effective agent. Dieldrin and aldrin (produced by the Diels–Alder reaction), heptachlor and chlorfenson are other examples.

The first of the organophosphorus compounds to be produced was HETP, the active ingredient of which was subsequently found to be tetraethyl pyrophosphate (TEPP); this was followed by the German discovery during the war of parathion, which proved effective against red spider on orchard and citrus fruits, aphids



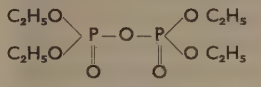
Aldrin



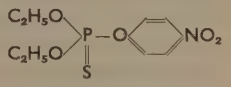
Heptachlor

where X = Cl
Y = H
or vice versa

and scale insects. The majority of the organophosphorus compounds are unfortunately highly poisonous to animals, and great care has to be taken when using them.

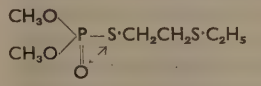


TEPP

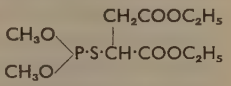


Parathion

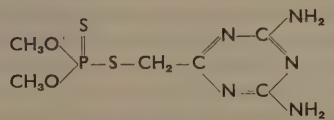
More recently, many less toxic compounds have become available, for example, demeton-methyl is widely used against aphids on sugar beet. Malathion and menazon have such high LD_{50} values that they can be considered as virtually non-toxic to mammals.



Demeton methyl

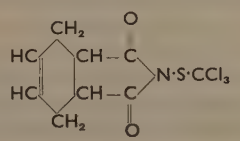


Malathion



Menazon

In the control of fungus diseases, cuprous oxide and copper oxychloride are now much used, and also organomercury compounds, thiocarbamates and nitrocompounds. Examples are thiram, bis or (dimethyl thiocarbamoyl) disulphide, zineb (zinc ethylene-1,2-bisdithiocarbamate), tecnazene (1,2,4,5-tetrachloro-3-nitrobenzene) and PMA (phenyl mercury acetate). One interesting application is for spraying Cox's apples that are affected by lime sulphur. Captan may be successfully used in this instance.



Captan

Research into compounds suitable for herbicides has led to the production of selective weedkillers, *e.g.* to kill the broad-leafed plants and leave grasses, or *vice versa*. The well-known MCPA (4-chloro-2-methylphenoxyacetic acid) and 2,4-D (2,4-dichlorophenoxyacetic acid) used on lawns is an example. Most of these are needed only in very small amounts, and their use has enabled the farmer to take full advantage of modern combine-harvesting techniques, since poppy and charlock may be killed without damaging cereals, the yield thus being greatly increased. In some areas weeds such as cleavers are present and, as these are not controlled by MCPA or 2,4-D, mecoprop (a methylphenoxypropionic acid) may be used.

Dalapon (α-α′-dichloropropionic acid) is very useful in market gardens. Application before the emergence of crops kills the weeds present. Another herbicide which acts similarly but has a longer-lasting effect is monuron (*N*-*p*-chlorophenyl-*N*′*N*′-dimethylurea).

Diquat (1,1′-ethylene-2,2′-bipyridilium dibromide) is a very effective herbicide and desiccant for the destruction of potato haulms. It may also be used as a defoliant and desiccant on cotton and lucerne. Propham (isopropyl-*N*-phenylcarbamate) is also useful in preventing the sprouting of potatoes in clamps.

Mr Baldit then mentioned briefly the research into growth regulators such as gibberellic acid. The results so far obtained in agriculture did not come up to expectations.

He then indicated by slides the increase in commercial chemicals, which has tripled in 10 years, although of nearly 185 produced in 1958 only about 30 are still used. Generally, the use of arsenicals has fallen very markedly and that of copper compounds such as Bordeaux mixture is about halved; the use of organo-chlorine and organo-phosphorus compounds, selective herbicides, thiocarbamates and so on increased tremendously in the same period.

The lecturer then pointed out that the use of small amounts of the new pesticides made the farmer's requirements more precise. The chemist had to formulate mixtures of the active ingredient in a carrier to suit the purpose for which it was intended, for example in a heavy dust for ground dusting, or with various solvents, wetting or emulsifying agents for liquid spraying. Machinery to apply the sprays had also to be redesigned and less bulk of pesticide is now needed. For example, in Kent orchards some 400 gal/acre was once needed, but now only 20–40 gal/acre is used, and in aerial spraying the figure is as low as $1\frac{1}{2}$–$2\frac{1}{2}$ gal/acre.

The lecture ended with a short colour film, 'Farming from the Air,' which illustrated the technique of aerial spraying.

In the discussion that followed, Mr Baldit clarified and amplified some of the information he had given.

The vote of thanks was proposed by Mr Griffiths, Chairman of the Dartford Branch of the Society.

Nitration and Nitrosation. Professor Sir Christopher Ingold, F.R.S., gave a lecture on 'Nitration and Nitrosation—A Contrast' at Battersea College of Technology on 1 December at a joint meeting with the College Chemical Society. Dr J. E. Salmon was in the Chair.

The lecturer outlined the nitration of aromatic compounds, pointing out that the same mechanism also held for the *N*-nitration of amines and the *O*-nitration of alcohols and of water. He then gave a detailed and lucid account of aromatic nitrosation, similar in context to the lecture previously reported (*J.*, 1958, 267). Finally he showed that in nitration all the theoretically possible nitrating agents were converted by S_N1 reactions to NO_2^+, the only active agent. In contrast, the possible nitrosating agents were interconverted by S_N2 reactions and, under suitable conditions, the active agent could be one of several species.

The vote of thanks was proposed by the Secretary of the College Chemical Society, Mr J. A. Hill.

Forensic Science. The third meeting of the Cambridge Sub-Section was held in the Lensfield Road Laboratories, Cambridge, on 6 December. Dr J. Williams, Chairman of the Sub-Section, introduced Dr F. G. Tryhorn, Forensic Science Adviser, Home Office, who delivered the lecture. Members of the local constabulary had been invited to attend.

Dr Tryhorn began by following the development of forensic science from its beginnings in Austria-Hungary at the end of the last century to the decision by this country in the early 1930s to set up laboratories devoted to the subject. Until that time all such scientific work had been carried out by various university and other scientific men. A Chief Constable's Committee was set up, the outcome being the decision to establish seven laboratories designed to provide 'scientific aids in detection,' the important word being 'aids.' At the same time, the training of police personnel was amended to include instruction on what these laboratories could and would do. The laboratories are staffed by civilians, contact with the police force being maintained, in part, by a police liaison officer who is both a scientist and a policeman. Dr Tryhorn emphasized that these laboratories are for the use of the defence as well as the prosecution, and said that he himself had appeared in court on behalf of the defence.

He then dealt with the work of the personnel in the forensic laboratories—biologists, chemists and physicists—and indicated the wide range of work covered and the apparently infinite variety of problems presented. The biologists' examination and grouping of blood samples, which may be presented as dried blood, scale and so on were described and illustrated by reference to a case in which human blood was detected on a slaughterhouse attendant's apron stained with animal blood in the course of the man's work. The examination of fibres of all types and of materials derived from these fibres,

such as cordage, string and paper, is also part of the duty of the biologist.

The main responsibility of the chemist is the analysis of the great variety of samples submitted; the most modern equipment is used. The lecturer said that toxicology could be one of the more time-consuming operations of the chemist's duties, although the use of paper chromatography and other techniques had speeded up the work. At this point, attention was directed to the 'fashions' in the choice of active agent used in suicidal poisoning. A study of coroners' reports showed a succession of peaks starting with morphine, then through oxalic acid, phenol and carbon monoxide to barbiturates, these drugs being the favoured agent in suicides at present. A vast amount of work was required in some homicide cases in which less common poisons had been used. In a case of poisoning by insulin, some 1,500 animals were used in experiments carried out by a team of workers over four or five months.

After dealing with the examination of blood and urine samples from drunken drivers, Dr Tryhorn finished his account of the chemists' work by mentioning the duties involved in cases of safe-blowing. The chemist's job could be a delicate one when the intruders had been disturbed at their work, leaving a lock or borehole packed with explosive to be disposed of without damaging the safe.

Dr Tryhorn ended his lecture by showing a series of slides illustrating the cases described.

The meeting ended with the vote of thanks proposed by Mr C. F. Hadley.

Photography in Scientific Research. A meeting held jointly with the Maidstone Photographic Society took place at the Old Palace, Maidstone, on 13 December.

Mr J. R. Barr, Chairman for the evening, introduced the lecturer, Mr K. G. Moreman, head of the photographic department at the Chester Beatty Research Institute.

He began by describing some of the equipment used in his department and then, by a series of extremely interesting slides, illustrated some of the work carried out, beginning with some ordinary photographic techniques for molecular models. He then showed apparatus used for ultra-violet photomicrography, with results using green light and ultra-violet radiation, and compared the qualitative and quantitative differences.

The use of the electronic flash for illuminating the subject was well illustrated in some photographs of animals, which could not always be controlled in order to obtain a sharp picture.

Colour photography yields exceptionally good results in many cases where black and white would yield low-contrast prints because of the appearance of the subject. Such a result was illustrated by a photograph of the mould Aspergillus, sensitivity to which could be produced in patients treated with cortisone.

An interesting aspect of photography was involved in the tracing of radioactive doses injected into mice. An exact life-size image of a longitudinal section of the mouse (frozen in liquid nitrogen to stop blood circulation instantaneously on death) was superimposed on a contact radiograph, which indicated the position of radioactive material, thus giving the exact position of the tracer in the body.

Mr Moreman then described the optical- and electron-microscope systems and showed some examples of optical photomicrographs and electron micrographs, including one of molecules of ferratin at a magnification of about 10^6, one of viruses (in which the 'heads' and 'tails' were clearly visible) and one of the long DNA molecule.

Interference microscopy combined with time-lapse cinephotomicrography permits the growth of living cells to be seen without recourse to ultra-violet radiation or staining, which could kill the organisms.

Mr Moreman ended his lecture with a composite cine film, illustrating time-lapse sequences made by Frank Smith in 1910 and present-day workers, including one by Dr Baijer showing the division of chromosomes.

The lecturer answered a number of questions; the vote of thanks was proposed by Miss Glenn, Chairman of the Photographic Society.

MANCHESTER AND DISTRICT

Chemistry in the Rubber Industry. On 7 December, at the Manchester College of Science and Technology, the Section Chairman, Dr L. R. Ridgway, delivered his address. He lectured with the authority of one who has served the rubber industry for the last 35 years. He introduced his lecture by describing the historica background of determining the chemical constitution of natural rubber. He continued by mentioning the development of the many polymers and copolymers based on such unsaturated compounds as isoprene, butadiene, styrene, acetonitrile and chloroprene, which culminated in the synthesis of *cis*-polyisoprene, identical with the natural rubber hydrocarbon.

Theories of the vulcanization of rubber were described. Since the discovery of vulcanization accelerators, the speed of the reaction and the number and location of intramolecular linkages can now be controlled. These organic chemicals include mercapto-benzthiazole, tetra-alkylthiuram disulphides and dithiocarbamates. The discovery and development of antioxidants, usually phenols, amines or their condensation products, made possible the protection of vulcanized rubber against oxidation and deterioration by heat and light. Some antioxidants give resistance to flexing, and protection against such metals as copper and manganese.

Dr Ridgway's personal interests have always been in the field of direct production of articles from rubber latex without passing through the more usual solid state. The various processes are dependent upon the

basic surface chemistry of the rubber particle in latex. Heat-sensitive gelling and ionic coagulation were described; these principles were demonstrated by a number of small rubber articles made from the latex during the course of the lecture.

Professor R. N. Haszeldine proposed the vote of thanks.

Annual General Meeting. The A.G.M. was held on 12 January in the new building of the Manchester Literary and Philosophical Society. The growing interest of members in the activities of the Section was shown by the increased attendance compared with recent years. As is usual on this occasion, book prizes were presented to a student from the University and each of the Technical Colleges. Dr Ridgway presented the prizes to C. J. Shaw (University of Manchester), R. K. Smalley (Royal Technical College, Salford), D. Ward (Bolton Technical College), B. B. Braddock (Manchester College of Science and Technology) and B. Turner (Stockport College for Further Education). Professor Haszeldine was unanimously elected as the new Chairman of the Section. The retiring Chairman, Dr Ridgway, was presented with a book token on behalf of the members of committee. Finally the new members of the committee, Mr H. K. Hartley, Dr J. M. Bruce and Mr J. H. W. Turner, were unanimously elected.

New Grade of Membership. The new grade of membership of the Institute was the subject of a talk given by Dr G. R. Ramage, *Vice-President*, immediately after the A.G.M. This was followed by a lively discussion and many questions. It was clear that there was general approval of the principle of the new grade. At the same time a number of speakers showed their concern that many graduates who were practising chemistry and qualified to enter the Institute under the present regulations were not availing themselves of membership.

Social Function. The Social Committee is actively making preparations for an Annual Dinner Dance to be held on 17 March at Belle Vue, Manchester. This is the first time that this event has been held for some years, and early application for the limited number of tickets is advisable.

MID-SOUTHERN COUNTIES

On 13 December Mr H. J. Hamblin gave a lecture on 'Agricultural Engineering' at the Poole Generating Station. The meeting was held jointly with the Poole Technical Group.

Dr Johnson, Home Office Pathologist, lectured on 'Poisoning: Accident, Suicide or Murder?' at a meeting held at the Grand Hotel, Bournemouth, on 6 January, in conjunction with the Bournemouth Section of the Pharmaceutical Society.

Both meetings were well attended and much enjoyed.

NORTH LANCASHIRE

On 19 November Mr B. F. Warner gave a lecture entitled 'Solvent Extraction Techniques in Irradiated Nuclear Fuels' at a meeting in Preston held jointly by the Section and the Society of Chemical Industry.

Mr Warner introduced his subject by reminding us of the fission process occurring in a nuclear reactor producing plutonium isotopes and highly radioactive fission products.

Problems relating to the processing of spent nuclear fuels were discussed. The process was then described in detail. Dissolution of the de-clad fuel element in nitric acid, with special attention to preventing the release of fission products and recovery of nitric acid, is followed by counter-current solvent extraction of the uranium and then of the plutonium after reduction to the trivalent state. The highly radioactive fission-product waste is evaporated to small bulk and stored. Design parameters for each section of the plant were discussed in detail. Mr Warner concluded his lecture by discussing the effects of radiolysis of solvents in the process and some of the special problems encounted in the disposal of radioactive wastes.

Mr H. Pritchard proposed the vote of thanks.

SHEFFIELD, SOUTH YORKSHIRE AND NORTH MIDLANDS

Polypeptide Chain Configurations. On 14 November, Professor W. T. Astbury, F.R.S., addressed a joint meeting with the Sheffield Section of the Chemical Society on 'Polypeptide Chain Configurations in the Fibrous Proteins.'

Professor Astbury reviewed the history of the subject up to 1950, and then went on to describe the three main underlying structural principles:

(*a*) in general, an operation repeated in three dimensions results in a helix;

(*b*) the maximum number of hydrogen bonds is formed;

(*c*) rotation is restricted, since the peptide link shows 40 per cent double-bond character.

The α-helix for the unstretched form of synthetic polypeptides (*e.g.* polyalanine), and its coiled-coil modification for that of the biological α-structures, were described, as also were the three possible 'pleated sheets' with linear hydrogen bonds for the three known extended β-forms:

(*a*)	Antiparallel	residue-length	about	$3\frac{1}{2}$	Å
(*b*)	Parallel	,,	,,	,,	$3\frac{1}{3}$ Å
(*c*)	Parallel-polar	,,	,,	,,	$3\frac{1}{10}$ Å

The observed 'repeat' for polyglycine-I is close to $2 \times 3\frac{1}{2}$ Å, but the calculated value for a fully-extended chain is 7·23 Å. A second form of polyglycine exists

with a trigonal structure, and it has been shown that the structure of collagen can be derived from this form (polyglycine-II) and the analogous structure of poly-L-proline. (Fibres of the collagen group contains 1/3 glycine residues and about 1/4 proline and hydroxyproline residues.) There are two crystallographic alternatives: collagen-I, in which (looking from the carboxy end) the NH groups point anti-clockwise, and collagen-II, in which they point clockwise; it is not agreed yet which is the correct answer, but collagen-I now seems the more convincing. Elastin is like collagen with regard to its proline and glycine content, but most of the polar residues, and in particular hydroxyproline, are replaced largely by valine. The X-ray pattern of elastin is similar to that of thermally-contracted collagen, and its structure was described in these terms.

Professor Astbury concluded with a description of the recently-established cross-β (supercontracted) form of the keratin and myosin group of fibrous proteins.

Professor R. D. Howarth, F.R.S., was in the Chair and Dr A. S. C. Lawrence proposed the vote of thanks.

Small-Scale Inorganic Analysis. A meeting was held at Rotherham on 14 December, at which Mr H. Holness gave a lecture on 'Small-Scale Methods in Inorganic Analysis' to a large audience, drawn from the students and staff of schools in the district. Mr Holness began with a comparison of the advances in semi-micro methods in inorganic and organic analysis. The technique as applied to organic analysis is at a very advanced state in all branches, whilst mention of semi-micro analysis in relation to inorganic chemistry always brings to mind qualitative analysis.

Mr Holness considered briefly macroanalysis (range 50 mg to 1 g) and micro-analysis (range 1 μg to 1 mg), and then went on to describe the role of semi-micro analysis in filling the gap. A film demonstrating the apparatus and techniques used in the analysis of an unknown mixture was shown. He described how, by employing a 5 mg sample, the concentration of ions was sufficiently high to be well within the limits of detection of the test methods used.

The lecturer then gave a brief description of the application of semi-micro methods to both preparative inorganic chemistry and quantitative analysis. The meeting was then thrown open for questions.

Dr Lawrence took the Chair, and the vote of thanks was proposed by Mr G. Robinson.

STIRLINGSHIRE AND DISTRICT

Ladies' Evening. A ladies' evening was held in the Mahratta Restaurant, Grangemouth, on 7 December by the combined local sections of the Institute and the Society of Chemical Industry. This was the second year such a meeting had been held, and once again a large number of members and their ladies attended.

The speaker on this occasion was Dr Magnus Pyke, F.R.S.E., who delivered a most lively and humorous address entitled 'Alcohol, Antibiotics, Cows and Chemistry.' The theme of Dr Pyke's talk was that life is a chemical process; he commenced by pointing out that a living body is continually expending energy and that this energy is derived from the fuel or food which is eaten. He went on to describe the experiments of Lavoisier and others which quantitatively derived the relationship between the oxidation of foodstuffs and the production of muscular energy. Carbohydrates may undergo oxidative or anaerobic breakdown, the latter occurring in muscle during periods of high muscular activity.

The breakdown of glucose to ethanol, *i.e.* fermentation, was then briefly dealt with. More energy, however, is obtained when the fuel is oxidized completely to water and carbon dioxide than by anaerobic means. Organisms capable of both methods are more economical in their fuel when air is given; this led to a brief description of yeast manufacture.

Dr Pyke proceeded to discuss moulds, bacteria and viruses, and pointed out that as much variation in size was found amongst micro-organisms as in the larger animals. The discovery of penicillin was described in considerable detail, followed by a discussion of the way in which micro-organisms are put to work in the field of sewage disposal. Sewage may be completely broken down by aerobic micro-organisms producing only carbon dioxide and water, or it can also be dealt with by a fermentation process, the micro-organisms used producing methane. This latter can be added to town gas as a fuel.

Dr Pyke concluded by saying that the cow summarized the whole lecture—oxidation of glucose, anaerobic fermentation in the muscles, while in the rumen micro-organisms are present which break down cellulose. Even methane is produced in the cow's rumen, and the story was then told of the scientist who introduced a fistula into a cow's rumen to study the contents; the open end of the fistula was exposed on the cow's flank and, out of consideration for the possible consequences to the cow, he had hung thereon a notice which read 'No Smoking!'

A vote of thanks to the speaker was proposed by Mr J. Oldham.

As an adjunct to the lecture an excellent and comprehensive illuminated exhibit was on view showing the different products available from fermentation industries.

TEES-SIDE

Micro-Organisms at Work. On 15 November Mr A. E. James gave a lecture on 'Micro-Organisms at Work.'

Mr James described how the activity of yeast cells had been used from ancient times for producing bread, alcohol and other materials. Yeast, which multiplies

by budding, is a name which covers a vast family of micro-organisms. Many tons of bakers' yeast are made annually under carefully controlled conditions. Micro-organisms are generally grown on a small scale, initially on a sterilized nutrient medium. The scale is increased in a stepwise manner. A particular culture can be stored in sterilized soil with a high loam content, or it can be put on a high-molecular-weight protein or carbohydrate and freeze-dried. More recently bacteria have been grown on the large scale. The lecturer described processes for producing the complex antibiotics of today, such as penicillin and streptomycin. He illustrated by slides the large tanks and plant used.

A vote of thanks was proposed by Dr A. A. L. Challis.

Exhibition of Films. On 7 December, in Stockton, the Annual Exhibition of Films was held. The films included 'Energetically Yours,' 'Once Upon a Sheep' and 'The Vineyards and Wines of France.'

THAMES VALLEY

Glass Blowing. A joint meeting of the Reading University Chemistry Society and the Section was held on 1 December at the University of Reading, when Mr J. A. Frost gave a most interesting lecture on 'Glass Blowing,' illustrated by two excellent films and by demonstrations. The proceedings were opened by Miss E. V. Egginton, who welcomed Section members and introduced the lecturer.

A film illustrating the manufacture of glass at Pilkington Bros Ltd was shown, in which the various steps in making plain glass, plate glass and various other specialities were described. This was followed by a prize-winning 'short' entitled 'Glas,' produced by Bert Haanstra, which combined artistry with information and well deserved its reputation.

Mr Frost commented on the films, and then discussed the use of special glasses for many purposes, from the point of view of the glass blower who has to produce a wide range of objects for use in many branches of industry. He pointed out that the annealing temperature and the linear coefficient of expansion are two very important properties in the selection of a glass for many purposes, and the importance of annealing a glass between its softening temperature and the transition temperature. He illustrated his lecture with a number of experiments.

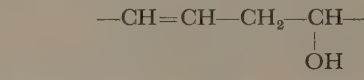
Dr F. M. Brewer proposed the vote of thanks.

Ladies' Evening. The Section held its annual Ladies' Evening on 13 January at Heelas', in Reading. After sherry and a buffet supper, members and their lady guests heard an illustrated lecture on 'Hair Condition and Beauty,' given by Mr T. P. McLaughlin of the toilet preparations development unit of Unilever Ltd. The speaker outlined the biological and chemical peculiarities of the hair, and showed how knowledge of these was used in the development of products for improving and decorating the hair, from the apparently simple shampoo to such techniques as dyeing and permanent waving. He particularly stressed the difficulties in obtaining reproducible results with the wide variations in the chemical and physical condition of the hair, and the extra problems imposed by carrying out reactions on the head under very mild conditions. The lecture was followed by a demonstration given by Mr H. L. Frowde and Mrs M. J. Roberts, also of Unilever. They were assisted by several young ladies from the University of Reading, who acted as models.

The lecture, which was introduced by Dr Brewer, was arranged by courtesy of Mr J. B. Wilkinson of Unilever Ltd, and organized by Dr F. W. Grimbleby, of the department of chemistry, University of Reading.

CEYLON

A joint meeting with the Chemical Society of Ceylon was held on 10 November at the University of Ceylon, Colombo, when Dr P. Veeravagu, lecturer at Aquinas University College, Colombo, gave a talk on 'The Thermal Condensation of α-ketoesters with Olefins.' He said that mono-olefins react thermally with a variety of dienophiles and reactive aldehydes to form 1 : 1-adducts whose structures have been rationalized in terms of a reaction involving a six-membered cyclic transition state. The mono-olefins β-pinene and allyl benzene condense thermally with methyl pyruvate to give 1 : 1-adducts. These adducts are α-hydroxy esters containing the β-hydroxy olefin moiety:



and their formation is also consistent with a six-membered transition state. Each of the above adducts, on pyrolysis, yielded the original olefin and methyl pyruvate, thereby establishing the reversibility of the condensation.

Pyrolysis of ricinoleic acid, the main fatty-acid component of castor oil, has been used for some time as a convenient route to obtain heptaldehyde and undecylenic acid. Ricinoleic acid and a number of other compounds containing the β-hydroxy-olefin moiety have been subjected to pyrolysis for short periods at temperatures near 500°C. The products formed in every case are readily explained by the six-membered transition-state mechanism referred to already. If this mechanism were valid, the hydrogen from the hydroxylic group of a β-hydroxy olefin should be found linked to the olefinic carbon farthest from the hydroxy group, at the end of the transformation. This has been confirmed by other pyrolysis experiments.

Many members joined in a discussion and the Chairman, Dr E. Rathenasinkam, proposed the vote of thanks.

Annual General Meeting. The A.G.M. was held on 10 December. The report and statement of accounts were presented and approved. The following were elected Officers and Members of Committee: Chairman, Mr N. Jayatunge; Vice-Chairman, Mr C. Satkunanan-than; Hon. Secretary and Hon. Treasurer, Dr R. O. B. Wijesekere; Members of Committee, Drs E. Rathenasin-kam and R. Sivaramalingam and Messrs J. P. R. Fonseka and W. R. N. Nathanael.

The meeting was followed by a social and film show held jointly with the Chemical Society of Ceylon.

DECCAN

Phosphates in Soils. A joint meeting with the Society of Biological Chemists, India, was held on 8 November at the Indian Institute of Science, Bangalore. Professor B. Sanjiva Rao, of the department of inorganic and physical chemistry, Indian Institute of Science, delivered a lecture on 'Fixation of Phosphates in Soils and its Bearing on Plant Nutrition.' Professor M. R. A. Rao presided.

Professor Sanjiva Rao pointed out that only a small portion of the phosphate present in soil or derived from fertilizers is actually available for uptake by plants, the major portion of the phosphorus being fixed as inorganic or organic compounds of the element. Microbial activity is responsible for fixation of phosphorus as phospholipids, phytin derivatives and nucleic acid. Organic phosphorus, however, mineralizes fairly readily, particularly on liming, and the element is made available to plants.

In recent years, fractionation of inorganic phosphates in soil has shown that besides the hydroxy phosphates of calcium (apatite), aluminium (variscite) and iron (strengite), a considerable fraction of the phosphate is in a highly unavailable form as sesquioxide phosphate covered with protective layers of the hydrous oxides of iron and aluminium that are very inert, owing to ageing.

The lecturer then discussed the recent advances in our knowledge of phosphate uptake by plants, as revealed by studies with ^{32}P, and how the uptake is affected by liming, the cation-exchange capacity of soil colloids and of plant roots, and the activity of calcium, aluminium and ferric ions in soil solution. He drew attention to the recent observation that the phosphates of iron and aluminium, when in colloidal form, are fairly available to plants, owing to their large specific surface. In studies on phosphate fixation, an application of the concepts of solubility product, common-ion effect and salt effect has yielded valuable results. He stressed the influence of pH on phosphate uptake and discussed the significance of the fact that $H_2PO_4^-$ activity at pH 6·7 was at its maximum in soil solution in equilibrium with solid phosphates of the three metals.

Professor Sanjiva Rao emphasized that in studying phosphate uptake due attention should be paid to nitrogen compounds and energy-yielding materials present in the soil–plant system. He indicated how practical use can be made of the facts that certain leguminous plants can pick up phosphorus efficiently from powdered rock phosphate and that the phosphorus in green leaves is highly available.

In conclusion, Professor Sanjiva Rao expressed the opinion that further work on the ageing of hydrous oxides and phosphates of aluminium and iron would yield results of practical importance in regard to phosphate availability.

After an interesting discussion, Professor D. K. Banerjee proposed the vote of thanks.

Forestry and Forest Industries. A meeting of the Section was held on 18 November at the Indian Institute of Science, Bangalore, when Mr B. N. Prasad, senior research officer, Forest Research Laboratory, Bangalore, delivered a lecture on 'Some Aspects of Forestry and Forest Industries.' Dr M. N. Ramaswamy presided.

In his introductory remarks, Mr Prasad pointed out that, although it might appear somewhat anomalous, forestry development has become a measure of civilization and use of forest products an index of standard of living.

India has only about 22 per cent of its total land area under forests, whereas the corresponding figures for Europe, North America and the U.S.S.R., for example, are 30, 39 and 51 per cent, respectively. It is of interest to note the quantities of timber used by every 1000 inhabitants in Asia, Europe, the Pacific area, the U.S.S.R. and North America, *viz.* 290, 900, 2000 and 2500 m^3, respectively.

Mr Prasad then dealt with conditions and possibilities in India. The quantity of usable timber from the forests is limited because numerous species of trees are unsuitable either for pulp manufacture or as timber. For the proper utilization of these species improved technological methods, including more effective seasoning and preservation, have to be employed. In order to meet the pressing demand for wood by the paper, plywood and lumber industries and so on and also for fuel, a change in the forestry management is necessary. There is a need for the plantation of suitable fast-growing species in the forests, which would give a perpetual yield of industrially useful wood in a short period of rotation. In the first instance about 1·5 million acres of land for such plantations is envisaged.

Finally, the lecturer recommended that greater use be made of processed wood, such as plywood, fibre-board, chipboard and particle board. Specimens and photographs of these materials were shown.

After a discussion, the vote of thanks was proposed by Dr B. H. Iyer.

Industrial Engineering. At a meeting of the Section held on 25 November at the Indian Institute of Science, Bangalore, Professor R. Natarajan, Professor of Industrial

Engineering and Administration, Indian Institute of Science, gave a talk on 'Industrial Engineering: Its Scope and Development in India.' Dr B. H. Iyer presided.

Professor Natarajan said that the scope and purpose of industrial engineering are not understood properly. In considering these aspects, he referred to the growth of science and engineering and their increasingly specialized branches which afford the scope and purposeful development of industrial engineering. He drew attention to the advancement of general science, to physics and its specialization in heat, light, sound and so on and to the further specialization, *e.g.* acoustics and supersonics in sound. Similarly, general engineering has given rise to branches such as civil, mechanical and electrical; electrical engineering, for example, has branched into high voltage engineering and communication engineering, and the latter into line communication and wireless communication, leading to specialization in high frequency and very high frequency.

An industrial enterprise consists essentially of in-puts such as materials and work, the processes done by machines and the methods, which result in an end product. An industrial engineer covers the whole range of this model. He is interested in the materials and machines, more so in the methods and most of all in men. He is equally interested in the final product and its disposal. This broad coverage, therefore, requires a breadth of knowledge, an orderly and analytical approach to problems and a thorough understanding of the economic and general social system in which the enterprise is placed.

The subjects covered in the industrial engineering course include: industrial psychology, industrial economics, finance, budgets and costing, marketing operations and market research, industrial organization, personnel management, production planning and control, statistical controls and work study. An industrial engineer looks not only to the present but the future. Automation is looming large and the industrial engineer will prepare himself to handle the problems arising out of automation. His future is full of complexities, but he is a 'must' to the future of industrialization.

After a short discussion two films were shown by courtesy of the Bangalore Branch of the Field Publicity Organization of the Government of India, the first being 'Dr M.V.'

The centenary celebrations in honour of Dr M. Visvesvaraya, the grand old man of Mysore, were held on 15 September. A long life spent in the service of his motherland and his achievements as a great engineer and administrator are depicted in this documentary. Beginning with his humble origin, the documentary goes on to show the brilliant academic career of Dr Visvesvaraya and his outstanding contributions, particularly in the fields of engineering, industry and education. The Krishnarajasagar Dam at Mysore, the Usmansagar and Himayatsagar Reservoirs at Hyderabad, the Bhadravati Iron and Steel Works in Mysore State and the University of Mysore owe their existence to the vision and imagination of Dr Visvesvaraya.

The second film, 'The Temples of Halebid and Belur', showed these temples in Mysore State which are perhaps the most magnificent of all the relics of the great Hoysala Empire, and representative of the style of architecture then prevailing. The Hoysaleswara Temple at Halebid was built in 1121 A.D. or a little earlier, and the Vijayanarayana Temple at Belur was completed in the twelfth century. As works of art, these temples and sculptures are among the most precious treasures of India's past, and masterpieces of medieval artistry and craftsmanship. The verses recited in the commentary of this film are from the collection of Vedic Hymns, the Rigveda, the oldest of India's scriptures.

In conclusion Dr S. C. Pillai expressed the thanks of the Section to Professor Natarajan for his interesting lecture and to Mr N. S. Venkoba Rao and Mr Gavirayappa, of the Field Publicity Organization, for their kind supervision of the screening of the films.

Biological Oxidation. On 6 December a joint meeting with the Society of Biological Chemists, India, and the Biochemical Society of the Indian Institute of Science was held at the Indian Institute of Science, Bangalore. Dr T. Ramasarma, department of biochemistry, Indian Institute of Science, gave a lecture on 'Biological Oxidation.' Professor P. S. Sarma was in the Chair.

Oxidation of foodstuffs, including carbohydrates and fats, is the principal source of energy in a living cell. An approach to the study of the mechanism of oxidation was first made by Warburg in his theory of oxygen activation and by Wieland and Thunberg, who put forward the theory of hydrogen activation. Warburg thought that the carbohydrates are broken down by oxygen in presence of iron catalyst, which he described as the respiratory catalyst or *Atmungsferment*. Wieland and Thunberg demonstrated that the primary step is dehydrogenation of the substrates. Keilin's discovery of cytochromes served to unify these rival theories and to develop a new concept of a respiratory chain with the dehydrogenase on one end and the cytochrome oxidase on the other. According to this concept, the oxidation is effected by step-wise transfer of electrons through the cytochrome system.

Another important development which provided the link between the respiratory chain and the oxidation of carbohydrates came out of the work of Szent-Gyorgyi, Ochoa, Lipmann, Lynen and Krebs on the oxidative breakdown of pyruvate to CO_2 and H_2O by way of cyclic reactions involving the following organic acids: citric, isocitric, α-ketoglutaric, succinic, fumaric, malic and oxaloacetic. These reactions are known as the citric

acid, tricarboxylic acid or Krebs cycle. During the oxidation of pyruvate by this cycle of reactions and the subsequent passage of electrons through the cytochrome system, energy is liberated. This is trapped by esterification of inorganic phosphate to form the terminal pyrophosphate bond of adenosine triphosphate (ATP), which is then supplied to the endergonic reactions of the cell.

The next important advance was made by Green, Potter, Schneider and Lehninger, whose work demonstrated that the citric-acid-cycle enzymes, electron-transport activity and the coupled phosphorylation occur together with all the necessary cofactors in the right proportions in one organized unit, which was identified as the previously-known cellular particle, the mitochondrion. It has been found essential to maintain the integrity of the structure of mitochondria, particularly that of the lamellae, or cristae, in order to couple phosphorylation with the oxidations. The recent discovery of a lipid-soluble quinone, coenzyme Q, which undergoes oxidation–reduction during electron transport and functions as a coenzyme in succinate oxidation by mitochondria, has opened a new phase in our understanding of this complex process. The recent observation by Todd that quinol phosphates undergo oxidation with simultaneous dephosphorylation in which a part of the phosphate appears as pyrophosphate indicates the possibility of coenzyme Q playing a similar role in mitochondria.

Thus our knowledge of the mechanism of oxidation has considerably improved, but there remain challenging problems as regards the intriguing structure of mitochondria in relation to their important function in electron transfer and coupled phosphorylation.

After a short discussion, Dr T. Ramakrishnan proposed the vote of thanks.

THE TEACHING OF INORGANIC CHEMISTRY

A one-day symposium on the teaching of inorganic chemistry at pre-university level will be held in the Donnan Laboratories, University of Liverpool, on 15 April. The symposium, which has been arranged to follow the Annual Meeting of the Chemical Society in Liverpool (11–14 April), is being organized by the Liverpool and North-Western Section of the Institute.

Among the speakers will be Professor C. C. Addison (University of Nottingham), Dr H. M. Irving (University of Oxford), Professor R. S. Nyholm, F.R.S. (University College, London), Dr A. G. Sharpe (University of Cambridge) and Dr J. E. Spice (Winchester College). Discussion sessions will form part of the programme.

Application forms may be obtained from 30 Russell Square, London, W.C.1, or from Mr H. R. Jones, The Central College of Further Education, Carlett Park, Eastham, Wirral.

News and Notes

AWARDS

Corrosion Group Essay Competition.—The Education Panel of the Corrosion Group of the Society of Chemical Industry, with the support of industrialists interested in the application of corrosion science in industry, will this year again award a prize of 25 guineas for an essay or paper on any aspect of corrosion of metals or its prevention. The competition is designed to encourage those who are still in the early stages of their career to take an interest in corrosion science and to express their ideas in writing. Essays are invited from persons aged not more than 30 years on the closing date for receipt of entries, 31 March. Results of original research may be incorporated, and a length of about 4,000 words is suggested. Further information may be obtained from the Corrosion Group Essay Competition, c/o The Society of Chemical Industry, 14 Belgrave Square, London, S.W.1.

Endeavour Prizes.—Prizes totalling 100 guineas are offered by Imperial Chemical Industries Ltd, publishers of the quarterly scientific review *Endeavour*, for essays submitted on scientific subjects. Prize winners will also receive invitations to attend the British Association meeting at Norwich from 30 August to 6 September. The primary purposes of these awards are to stimulate younger scientists to take an interest in the work of the British Association and to raise the literary standard of scientific writing. The competition is restricted to those whose 25th birthday falls on or after 1 June. Further details may be obtained from *Endeavour*, North Block, Thames House, Millbank, London, S.W.1.

EXHIBITIONS AND COURSES

Automatic and Semi-Automatic Methods.—A Symposium and Instrument Exhibition on 'Automatic and Semi-Automatic Methods in Analysis and Control' will be held at the Medway College of Technology on 16 March. The morning session will be devoted to lectures and discussion, and in the afternoon apparatus will be exhibited and demonstrated by manufacturers. Further details may be obtained from the Course Organizer, Dr D. T. Burns, Department of Science, Medway College of Technology, Maidstone Road, Chatham, Kent.

Corrosion.—A course of 12 lectures on Corrosion is being held in the department of chemistry and biology, West Ham College of Technology, on Mondays at 7 p.m. Subjects include microbiological corrosion, metallic coatings, the preparation of metals for painting, anti-corrosion paints and zinc coatings. The course fee is £1. Further details may be obtained from the

Principal, West Ham College of Technology, Romford Road, Stratford, London, E.15.

Oil and Colour Chemists' Association.—As already announced (*J.*, 1960, 302) the Thirteenth Technical Exhibition will take place on 6–9 March in the New Hall of the Royal Horticultural Society, Greycoat and Eleverton Streets, London, S.W.1. The opening ceremony will be performed by Sir Cyril Hinshelwood, O.M., F.R.S., at 3 p.m. on 6 March. The official guide to the exhibition is now available, and may be obtained from the General Secretary, Mr R. H. Hamblin, Wax Chandlers' Hall, Gresham Street, London, E.C.2.

MEETINGS AND CONFERENCES

Biochemical Society: 50th Anniversary Meeting.—Arrangements for the Meeting to be centred on University College, London, during 27-29 March include a symposium (at the Senate House, University of London) on 'The Structure and Biosynthesis of Macromolecules', which will occupy 27 March and the morning of 28 March. A conversazione will be held in the evening of 27 March, and on the afternoon of 28 March the Hopkins Memorial Lecture will be delivered by Sir Hans Krebs at the Royal Institution. On 29 March the morning will be devoted to original contributions; the A.G.M. of the Society will take place in the afternoon; and in the evening Viscount Hailsham will be the guest of honour at the Anniversary Dinner. Inquiries about meetings should be addressed to Dr W. J. Whelan, Lister Institute of Preventive Medicine, Chelsea Bridge Road, London, S.W.1.

Chemical Engineering Congress.—The Institution of Chemical Engineers is organizing the Third Congress of the European Federation of Chemical Engineering, which will be held on the occasion of the Second Chemical and Petroleum Engineering Exhibition at Olympia, London, on 20–26 June, 1962. There will be three technical meetings at the Congress, a three-day symposium on Interaction between Fluids and Particles, a one-day meeting on Process Optimization and a one-day symposium on the Handling of Solids. Suggestions for papers for inclusion in the programme are invited. Titles and summaries should be sent to the General Secretary of the Institution, 16 Belgrave Square, London, S.W.1, not later than 30 April.

Chemical Institute of Canada.—A symposium on Titrimetric Methods of Analysis, sponsored by the Analytical Chemistry Division of the C.I.C., will be held in Cornwall, Ontario, on 8–9 May. Three aspects will be emphasized, complexometric titrations, electrometric titrations and titrations in non-aqueous solvents.

A symposium on Co-ordination Compounds will take place on 15–16 May in Hamilton. Speakers include Drs A. Cotton, W. C. Fernelius, S. Kirschener and E. L. Muetterties. The chairman is Professor R. J. Gillespie.

Inquiries may be addressed to the Institute at 48 Rideau Street, Ottawa 2, Ontario.

Chemical Society.—The Society is holding a symposium on Terpene Chemistry at 10.30 a.m. on 23 February. It will take place in the large chemistry lecture theatre of the Imperial College of Science and Technology, London, S.W.7. The speakers are Professors F. Sorm, B. C. L. Weedon, O. Jeger, H. G. H. Erdtman, J. M. Robertson and D. H. R. Barton.

The Anniversary Meetings of the Society will be held in Liverpool on 11–14 April. The programme includes two symposia, Developments in the Chemistry of Boron Compounds and Some Aspects of the Chemistry of Natural Products, and a number of visits and social events.

Further details of these two meetings may be obtained from the General Secretary, The Chemical Society, Burlington House, London, W.1.

Colour Group.—The Colour Group of the Institute of Physics and the Physical Society is holding a Science Meeting on 22 February, when Dr V. S. Griffiths will lecture on 'Colour and Chemistry'.

A three-day conference to celebrate the centenary of Maxwell's original discourse on Colour Reproduction is being organized jointly by the Institute of Physics and the Physical Society, the Colour Group and the Inter-Society Color Council of America. The meeting will take place in London on 16–18 May.

A conference on Practical Applications of Colour Sciences is to be held in Düsseldorf on 23–26 May, under the auspices of the German Fachnormenausschuss Farbe (FNF) im Deutschen Normenausschuss and the French Centre d'Information de la Couleur. Full details of these meetings may be obtained from the Hon. Secretary of the Colour Group, Mr A. W. S. Tarrant, Spectroscopy Department, Battersea College of Technology, London, S.W.11.

Electronic Bombardment.—The Joint British Committee for Vacuum Science and Technology announces that the Société Française des Ingénieurs et Techniciens du Vide will be holding an international symposium in Paris on 21 April on *Applications métallurgiques du bombardement électronique.* Further details may be obtained from Madame J. Mainier, Secrétariat Administratif, 147 ter A, Boulevard de Strasbourg, Nogent sur Marne, Seine, France.

Faraday Society.—On 27 June the Society is holding a Colloid Centenary Symposium, to celebrate the appearance of Thomas Graham's famous paper in which he first clearly defined the meaning of a colloid. This informal discussion meeting will take place at the

Royal College of Science and Technology, Glasgow, where Graham was formerly professor. Speakers include Sir Eric Rideal, Professor J. A. V. Butler, Dr A. S. C. Lawrence and Dr A. P. Prosser. The chairman will be Mr D. C. Henry. Further information may be obtained from Dr A. J. Hyde, Department of Chemistry, Royal College of Science and Technology, George Street, Glasgow, C.1.

Formation and Structure of Paper.—A second international meeting of high scientific calibre is being organized by the Technical Section of the British Paper and Board Makers' Association. The first was held in Cambridge in 1957 to survey fundamental aspects of fibres and their treatment for papermaking. The second symposium, Formation and Structure of Paper, will be held at the Dyson Perrins Laboratory, Oxford, on 25–29 September. A maximum of 250 applications can be accepted for the symposium, the fee for which is at present estimated to be £12. Full details may be obtained from the office of the Technical Section, St Winifred's, Welcomes Road, Kenley, Surrey.

Pure and Applied Chemistry.—Leading scientists from many countries will speak at the 18th International Congress of Pure and Applied Chemistry, to be held in Montreal, Canada, on 6–12 August. Plenary lecturers will be Professors F. S. Dainton, R. Daudel, G. Schwarzenbach and R. H. Wilhelm. The conference will deal with four divisions of chemistry—physical, applied, analytical and organic—and some 70 sectional lecturers will be delivered. Further details may be obtained from the Publicity Chairman, P. A. Novikoff, Public Relations, Canadian Industries Ltd, Box 10, Montreal, Canada.

Rheological Techniques.—The British Society of Rheology and the Non-Destructive Testing Group of the Institute of Physics and the Physical Society will hold a joint meeting on Rheological Techniques at Llandudno on 21–22 September. Discussion of experimental results is often given at the expense of description of techniques, but it is intended that the opposite will be true on this occasion. Contributions to the meeting are invited, and intending speakers should write as soon as possible to Dr M. F. Culpin, 8 The Broadway, Pontypool, Monmouthshire.

Society for Analytical Chemistry.—The Annual General Meeting of the Society will be held at 2.15 p.m. on 3 March in the Meeting Room, Royal Society, Burlington House, Piccadilly, London, W.1. The A.G.M. is restricted to members of the Society, but visitors will be welcome to attend the address of the retiring President, Mr R. C. Chirnside, on 'The Enlargement of Horizons in Analytical Chemistry' at approximately 2.45 p.m. In the evening the Society will hold its Biennial Dinner at Fishmongers' Hall, London Bridge.

Water Treatment and Examination.—The Society for Water Treatment and Examination is holding its ninth Annual General Meeting on 17 March. The meeting will take place at 9.30 a.m. in the Library, Royal Society of Health, 90 Buckingham Palace Road, London, S.W.1, and will be followed (10.30 a.m.) by a symposium on Application of Laboratory and Pilot Plant Studies to full-scale water and effluent treatment. The speakers are Dr G. Carter, Mr A. H. Waddington and Mr R. W. Bayley. Further details may be obtained from the Hon. Secretary of the Society, Mr. A. W. H. McCanlis, 41 Carshalton Road, Sutton, Surrey.

EDUCATIONAL

D.S.I.R. Awards.—A booklet entitled *D.S.I.R. Studentships and Fellowships 1961* has recently been published (H.M.S.O.: 1*s.* 9*d.* net). It gives full details of the different types of studentships and fellowships in science and technology to be offered by the D.S.I.R. in 1961, and describes the method of application.

Another publication, entitled *D.S.I.R. Research Grants 1961* (H.M.S.O.: 1*s.* net), provides information about grants for special research awarded by the D.S.I.R. to investigators who are already of acknowledged standing in their subjects.

Scholarships Abroad 1961-62.—Details of scholarships for the academic year 1961–62 that are offered to British students by governments and universities in foreign countries are published in a booklet, *Scholarships Abroad, 1961–62*, issued by the British Council, 65 Davies Street, London, W.1. The following countries are offering such scholarships: Austria, Belgium, Brazil, Denmark, Finland, France, Germany, Iceland, Indonesia, Iran, Italy, Japan, the Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland and Yugoslavia. The booklet also contains details of other awards tenable abroad under, for instance, the Commonwealth Scholarship and Fellowship Plan.

Technical Authorship.—A new scheme of syllabuses and examinations in Technical Authorship was announced in April, 1958, by the City and Guilds of London Institute. The first examination at Ordinary level was held in 1960 at 18 centres, and of the 113 candidates who submitted themselves for examination, 30 were successful. It seems probable that a large proportion of the candidates were practising technical authors, and the result of the examination would appear to indicate that training in this craft will be of great value to industry. It is hoped that many of the successful candidates at the Ordinary examination will proceed to attempt that at Advanced level. The first Advanced examination will be arranged in 1961.

P.S.A.B. CONVENTION

The third largest industry in the country, 'The Chemical Industry,' was the subject of the 34th Careers Masters Convention of the Public Schools Appointments Bureau held in London on 2–6 January this year.

The convention was organized by Shell International Chemical Company Ltd, in conjunction with the P.S.A.B., on behalf of the sponsoring companies: Albright & Wilson Ltd, Courtaulds Ltd, the Distillers Company Ltd, Fisons Ltd, Imperial Chemical Industries Ltd, Monsanto Chemicals Ltd, and Shell Chemical Company Ltd. Altogether 70 delegates from the schools were present, with officers of the Southern, Midland and Northern Branches of the Bureau as guests of the chemical industry.

Sir Miles Thomas, in his 'Introduction to the Chemical Industry,' emphasized the importance of careers advice both for the companies and for the country as a whole.

A Shell Photograph

Left to right: Sir Miles Thomas, Chairman, Monsanto Chemicals Ltd; Mr F. H. Braybrook, Shell International Chemical Co.; and Sir Owen Wansbrough-Jones, director, Albright & Wilson Ltd

If boys choose wisely, he said, the country benefits. Today our skill in brain power is our only natural wealth—and we cannot waste it *now*. Our very existence depends on their choice and they must have the best advice that is available. Such advice is too important to be taken lightly.

Further addresses were given by Sir Owen Wansbrough-Jones (Albright & Wilson Ltd) on 'Research Work in the Chemical Industry'; Mr C. F. Kearton (Courtaulds Ltd) on 'Opportunities in Chemical Manufacture'; Mr D. R. Mackie (Monsanto Chemicals Ltd) on 'Sales'; and by officials in the firms which were visited.

Visits were made to the Distillers Company at Epsom; the Shell Chemical Company at Shell Haven; Fisons Fertilizers at Stanford-le-Hope; and I.C.I. Plastics Division at Welwyn Garden City. Finally, on behalf of the sponsoring companies in the chemical industry, Mr W. F. Mitchell (director, Shell International Chemical Company Ltd) presided over a Convention Dinner held at Grosvenor House Hotel.

The convention was attended by representatives from the following schools and colleges:—

The Leys, Durham, Leighton Park, Hymers, Ashville, Monkton Combe, St Edmund's, Liverpool, King's (Rochester), Portora Royal, King William's (Isle of Man), Ipswich, Loretto, St Dunstan's, Alleyn's, King Edward VII (Lytham), Ardingly, Bryanston, Shrewsbury, Repton, Victoria (Jersey), Llandovery, Loughborough, Reed's, Canford, Whitgift, Bloxham, Marlborough, Lincoln, Oundle, Bristol Grammar, St George's (Weybridge), King's (Taunton), West Buckland, Bootham, St Bees, Stonyhurst, Merchant Taylors' (Crosby), Mill Hill, Brighton, St Olave's, Ratcliffe, Brentwood, Monmouth, Bromsgrove, Wellingborough, Fettes, Rossall, Norwich, Abingdon, Bedford, Kelly, Christ (Brecon), Merchiston Castle, Harrow, Uppingham, Kimbolton, Charterhouse, Caterham, Queen Elizabeth's (Blackburn), St Alban's, Dollar Academy, William Hulme, St John's (Leatherhead) and the Edinburgh Academy.

Copies of the Institute's new 'Training Guide' and 'Looking to Chemistry for a Career' were issued to each delegate at the Convention.

M. G. C.

COMMONWEALTH TECHNICAL TRAINING WEEK

Preparations are now well in hand in centres in many parts of the United Kingdom for the Commonwealth Technical Training Week which will be held from 29 May to 4 June. There are many signs of the vigour and imagination for which H.R.H. The Duke of Edinburgh called when he launched the project on Commonwealth Day in 1960. Indeed, he himself is giving a vigorous lead, for he will take part in the inaugural function at Guildhall on 29 May, attend the service at St Paul's Cathedral on 1 June and visit Scotland, Wales, Northern Ireland and Birmingham during the Week.

" Throughout the area of the London County Council the work is being undertaken by sub-committees of the Council's youth employment committees, to which representatives of the City of London and the Metropolitan Boroughs have been appointed. Already programmes are taking shape and visits of employers to schools, processions of decorated vehicles, sporting activities and dances, shop-window displays and lunch receptions for young people able to show exceptional achievement are of special interest among the varied lists of events that are foreshadowed.

In Edinburgh, where there will be a service in St Giles' Cathedral, the main activity will centre around an exhibition in the Waverley Market lasting throughout the Week. Here industrial and commercial firms will

display something of their schemes of training and career opportunities, while educational institutions will provide information about themselves, with demonstrations of students at work.

In Belfast the proposed arrangements include a government function at Parliament Buildings, Stormont; a civic function; a careers exhibition in the King George VI Memorial Hall; an exhibition of students' work in the College of Technology; and an open day at the Sports and Social Club of Short Bros and Harland Ltd.

From Cardiff comes the news that among the events under consideration are a service in Llandaff Cathedral; the formal opening of the Welsh College of Advanced Technology; a procession of apprentices and trainees through the streets of Cardiff, with tableaux from different industries; a garden party for all Commonwealth students in Wales and selected Welsh apprentices; and a Ball for Commonwealth students.

Similar activity is reported from smaller cities, towns, urban and rural districts through the country and from territories, both great and small, throughout the length and breadth of the Commonwealth.

The co-ordination and central organization of activities in the U.K. is being dealt with by the City and Guilds of London Institute, 76 Portland Place, London, W.1, to whom any general inquiries should be addressed.

The Institute, together with other professional bodies and large organizations, has been approached to support careers conventions in various parts of the country by providing suitable displays of careers literature and/or arranging for speakers to address careers meetings. Such arrangements are proceeding with the co-operation of Local Section Committees.

CORRESPONDENCE

Advantages of a Chemical Approach

Sir,—Would it not be possible, after the manner in which Dr F. H. Day has advocated the advantages of a geochemical approach to the study of chemistry (*J.*, 1960, 417), to put forward pleas equally alluring for the advantages of the astronomical approach, the engineering approach, the gastronomical approach, the oceanographical approach or the Russian approach to the study of chemistry?

I feel sure that for all such approaches enthusiasts would never be at a loss to think of useful illustrations of chemical principles, of material to stimulate the interest of the student, and of topics that are valuable in themselves to the proper understanding of chemistry, its interrelationships and interdependence with other sciences and the humanities (I feel sure that Dr Day forgot, in his very lucid account, to mention the latter!). Of course, Dr Day will claim the superiority of his geochemical approach over other approaches because he is enthusiastic for the one and not for any others—at any rate, he has not so far disclosed his enthusiasm for any other approaches.

It is now some years since I drew attention to the eclectic tendency of chemistry shown in the *Study Guide* (*J.*, 1957, 401). What I meant by this is the tendency of the teacher, assessor and examiner of chemistry to expect the student to be acquainted with an ever-increasing number of subjects which do not form part of the main stream of chemistry. 'Had we but world enough, and time', students might easily master all approaches to their subjects, but I can well understand their protesting ' "but at my back I always hear Time's winged chariot," in the form of Part I or Part II Grad.R.I.C., "hurrying near." ' Dr Day admits that 'no teacher would wish to impose deliberately even heavier burdens on chemistry students but . . . .'

The trouble with advocates of approaches is that they are enthusiasts, and to the currier there is nothing like putting someone into a leather harness! So Dr Day must have geochemistry represented in the three main branches of chemistry and let the subject range between the highly speculative origin of the elements and the highly speculative origin of life. I cannot deny completely the value of approaches, but how are they to be kept within reasonable bounds for the sake of the student? There seems to be only one suitable way, which is to extend the system of internal examinations. Then the enthusiasms of teachers can be used as approaches to the study of chemistry, subject to the safeguards of a system of external assessment of syllabuses and examinations. Students of chemistry who work 'while it is day' in Carlisle might reasonably expect to be examined there in a geochemical approach, but otherwise in other places. Indeed, there may even be a city where there will be enthusiasm, reflected in teaching and in examining, for a *chemical* approach to the study of chemistry!

G. N. Copley

17 Calderstones Avenue,
Liverpool, 18

(Dr Day's original title would not have given Mr Copley the handle he has turned so vigorously; this was our doing—Ed.)

Maslin etc.

Sir,—You may be interested to know that *mashlum* is still in current use in the West of Scotland for a crop consisting of a mixture of beans and oats. It is used for cattle feeding. The beanstalks help to keep the oats from lying in windy weather.

A. P. Orr

Marine Station,
Millport,
Isle of Cumbrae, Bute

OBITUARY

Arthur Price Backshell. *B.* 12.12.01. *Ed.* Hereford High School; Birmingham Municipal Technical School, 1918–20; University College, London, 1929–32. He became an assistant in the Laboratories of King's Norton Metal Co. (now Imperial Chemical Industries Ltd) in 1918, and took a similar post at Courtaulds Ltd, Flint, in 1921. He was appointed departmental manager (viscose, bleaching and finishing) to Toyo Rayon Kabushi Kaisha, Japan, in 1926. A few years later he returned to England and took a post as growers' representative with the Ely Beet Sugar Co. in 1933. The following year he joined British Industrial Solvents, a division of the Distillers Co. Ltd, as chemist in charge of the derivatives section. In 1935 he became relief process superintendent, and in 1939 process superintendent. After the war he took charge of the works analytical laboratory, a position he held for four years until he became training officer. At the time of his death he was chief safety officer of the chemical division, Distillers Co. Ltd. He was a keen member of many technical societies, for several years being secretary of the Hull Chemical and Engineering Society and President in 1951. He was a founder member of the Hull and District Section of the Institute, and served as a District Member of Council in 1953–56. He was also a Fellow of the Royal Society of Arts. He had a particular interest in furthering the education of young students, and was a member of the Committee for Further Education in Yorkshire. He was for many years a member of the Hull and District Safety Council, being Chairman in 1959 and latterly Vice-President. (*A.* 1933, *F.* 1943; Council 1953–56). *D.* 18.10.60.

Norman Joseph Booth. *B.* 24.5.02. *Ed.* Manchester Grammar School; Manchester College of Technology, 1919–22. B.Sc.Tech. He became chief chemist at the Lancashire Foundry Coke Co. Ltd, Accrington, in 1922. He was appointed lecturer in chemistry at the Chesterfield College of Technology in 1935, and in 1948 was promoted to head of the science department, a post which he held at the time of his death. He was awarded the degree of M.Sc.Tech. (Manc.) in 1940. (*A.* 1931, *F.* 1941). *D.* 22.9.60.

James William George Brooker. *B.* 3.2.1880. *Ed.* Finsbury Technical College, 1897–1900. He became an analytical and research assistant at the Imperial Institute in 1901. Later he joined Price's Patent Candle Co. Ltd (now Price's [Bromborough] Ltd), and at the time of his retirement was technical director. (*A.* 1903, *F.* 1907). *D.* 10.10.60.

William Howieson Gibson. *B.* 20.2.1885. *Ed.* University College, London, 1903–06. B.Sc.Econ., D.Sc. In 1907 he joined the Research Department, Royal Arsenal, Woolwich, where he remained until 1919; he was connected with much important work on the explosives used in the First World War. In recognition of his war-time services, he was appointed M.B.E. in 1918 and O.B.E. in 1920. In 1919, he transferred his interests to research in the linen industry and for seven years was in charge of the research department of the York Street Flax Spinning Co. Ltd, Belfast. In 1926 he was appointed director of research, Linen Industry Research Association, in succession to the late Dr J. Vargas Eyre. His initiative in fostering the large-scale saving of pedigree flax seed, and in developing novel commercial methods of extracting flax fibre, led directly to the rapid expansion of flax-growing and to the establishment of flax factories in the United Kingdom and the Commonwealth in 1939–45, ensuring the supply of flax fabrics vital to the armed services. He resigned in 1939 and returned to the Research Department, Royal Arsenal, Woolwich, where he remained until his retirement in 1950. He was a founder-member and first Honorary Secretary of the Belfast and District Section of the Institute. (*A.* 1917, *F.* 1921; Council 1924–26, 1928–31). *D.* 28.7.60.

Sydney Lionel Levy. *B.* 26.3.01. *Ed.* Manchester Municipal Secondary School; Manchester College of Technology, 1918–21. B.Sc.Tech. He became a chemist at the Riverside Bleaching & Finishing Co. Ltd in 1922 until 1926, when he took up private tutoring in chemistry, physics and mathematics. He was appointed chemist to the Manchester Smelting Co. in 1929, and joined the Shell Refining & Marketing Co. Ltd (later Shell Refining Co.) in 1940. At the time of his death he was a research chemist at the Thornton Research Centre of Shell Research Ltd. (*A.* 1947). *D.* 4.6.60.

John Leonard Lizius. *B.* 7.3.1893. *Ed.* Holloway County Secondary School; University College, London, 1911–16. B.Sc. He served in H.M. Forces in France as a lieutenant in the Special Brigade, R.E., 1916–18, and when he was invalided out he became a works chemist in the R.E. Anti-Gas Department of the War Office. A year later he took a post as chief research chemist at Allen & Hanburys Ltd, remaining until 1922, when he was forced to abandon his work because of a breakdown in health. In 1926 he became a research assistant to Dr G. N. White, consulting chemist, and in 1928 joined the chemical defence research department of the War Office in a similar capacity. His engagement terminated in 1931, and owing to continued ill-health he had no regular employment for some years. In 1941 he entered the chemical inspection department of the Ministry of Supply as an experimental officer, and was promoted to senior experimental officer in 1947. He retired in 1950. (*A.* 1918, *F.* 1948). *D.* 9.7.60.

John Alexander McRae. *B.* 24.1.1890. *Ed.* Gravenhurst High School; Queen's University, Kingston, Ontario, 1906–09; University of Manchester, 1919–21. M.A. (Queen's), Ph.D., D.Sc. (Manc.). He was a Milton Hersey Fellow at Queen's University, 1909–11. Thereafter, he became a demonstrator at the University of Toronto, 1911, lecturer in chemistry, Queen's University, 1912, Associate Professor, 1922, Professor, 1926, and Professor and Head of Department, 1941. On his retirement in 1956, he was made Emeritus Professor and awarded the degree of LL.D. During his academic career at Queen's University, McRae carried out for more than thirty years a heavy programme of lectures, laboratory supervision and general administration. Nevertheless, he contrived to maintain an output of original work recorded in numerous papers in the *J. chem. Soc.* McRae always had great interest in the progress of his students and in their personal welfare. He had a friendly disposition and a generous nature, and was totally sincere in all he said and wrote. (*A.* 1911, *F.* 1915). *D.* April, 1960.

David Millin. *B.* 5.9.1890. *Ed.* South African College School; South African College (now the University of Cape Town), 1907–09. B.A. (Cape). He received further professional education at the Royal School of Mines for two years. He was appointed senior lecturer in metallurgy at the University of the Witwatersrand, where he remained for 35 years until his retirement in 1955. Thereafter he acted as consulting metallurgist to the Electrolytic Metal Corporation Ltd, Johannesburg. During 1930, he assayed the first samples from the Orange Free State goldfields. He was a keen sportsman, playing rugby in his earlier years, and golf and bowls later. (*A.* 1914, *F.* 1918). *D.* 29.4.60.

Herbert Richard Neech. *B.* 21.3.1879. *Ed.* Lincoln Municipal Technical School, 1890–95. He joined Morris & Co., Doncaster, as an apprentice in 1895, and five years later was appointed an assistant chemist with the same firm. Thereafter he became successively technical manager with Productos Chemicos de Huelva, an associate company of the Rio Tinto Co., 1905; chemical engineer, W. J. Fraser & Co. Ltd, London, 1907; and consulting chemist in practice in Lincoln, 1909. During the First World War he served on the technical staff of the Ministry of Munitions at H.M. factories at Queensferry and Gretna. In 1920 he joined Brands Pure Spelter Co. Ltd, Irvine, as works manager, and six years later took a similar post with Irvo Fertilisers Ltd, Irvine. In 1928 he joined Imperial Chemical Industries Ltd as a technical chemist, and remained with that company until the outbreak of the Second World War, when he was seconded to the Ministry of Supply as consultant to the D.O.F.(X). He returned to Imperial Chemical Industries Ltd in 1943 and retired shortly afterwards. His keen interest in helping others and his kindly approachable manner endeared him to all who knew him. He maintained during his years of happy retirement a close contact with his old colleagues and enjoyed to the full his interest in gardening, reading and decorating. (*A.* 1919, *F.* 1943). *D.* 9.7.60.

Conrad Gallimore Wenyon. The following extract from the *Hexagon Courier*, November, 1960, supplements the information given in *J.*, 1960, 452:

Mr Wenyon, who retired in 1953 after more than 38 years' service, started work with The New Explosives Co. at Stowmarket in 1915, a company which later became part of Paints Division. Three years later he moved to the then new Dalton Works of British Dyes Ltd at Huddersfield where he was engaged for 23 years on the manufacture of intermediates and rose to the post of Assistant Works Manager. In 1941 he was appointed Works Manager at Trafford Park. It was during his period of office there that the manufacture of penicillin from the laboratory scale in glass dishes to the large scale, deep-culture method in fermenters, was developed. Mr Wenyon was also well known for his achievements in games and sports—at one time he held the Scottish Amateur Swimming Championships for 100 and 200 yards, and was a Yorkshire Chess Champion.

THE REGISTER

NEW FELLOWS

BRICKNELL, Alan George, M.SC.(LOND.), PH.D.(SASK.), A.R.C.S.

ASSOCIATES ELECTED TO THE FELLOWSHIP

(P) BANFIELD, Reginald Henry, B.SC.(LOND.)
(P) CUMMINGS, William George, B.SC.(LOND.)
(C) DOWSON, William Montague, B.SC.(LOND.)
(P) DUFFIN, George Frank, B.SC., PH.D.(LOND.)
(P) DUNN, Leonard Joseph, B.SC., PH.D.(LOND.), D.I.C., A.R.C.S.
(P) GODDEN, Edwin Percy, B.PHARM.(LOND.), F.P.S.
(SS) GRUDGINGS, Donald Malcolmson, B.SC.(LOND.), A.R.C.S.
(P) JONES, Norman Richard, B.SC.(LOND.)
(P) KITTERINGHAM, George Reymond, B.SC.(LOND.), F.P.S.
(SS) LANCEFIELD, Roger Noel Derrick
(F) MURRAY, John Patrick, A.M.INST.F.
PANTON, Francis Harry, M.B.E., B.SC.(LOND.), PH.D.(NOTT.)
(P) PHILLIPS, Gordon Victor
(E) SAUNDERS, Rex Arthur, B.SC.(S'TON)
(P) TEW, Harold James, B.SC.(LOND.), A.I.R.I.
(P) UNSWORTH, Alfred Kenneth, M.SC.(LOND.), A.P.I.
(S) WARD, Donald Leslie
(OB) WILLIAMS-WYNN, David Ernest Arthur, B.SC.(S.A.), M.SC.(RHODES)
(N) WOOD, Claude Helm

NEW ASSOCIATES

(P) ANSTICE, Euan Christian MacLaren, B.A.(CANTAB.)
(P) BENWELL, Cyril Harry
(P) BREAM, John Bernard, M.SC.(MANC.)
(OJ) FERNANDO, Wannakuwattewaduge Errol Francis Hector, B.SC.(CEYL.)
(OB) HARDING-BARLOW, Ingeborg, B.SC.(CAPE T.)
(P) HARDISTY, David Robert, B.SC.TECH., PH.D.(MANC.), A.M.C.T.
(P) HARPER, Kenneth Herbert, B.SC.(MANC.), PH.D.(LOND.)
(U) HARRIS, Vincent Hugh, B.SC.(LEEDS), PH.D.(SHEFF.)
(H) HARRISON, Raymond, B.SC.(DURH.)
(P) HUMPHREYS, Keith Wood, M.A., PH.D.(CANTAB.)
(Q) LLOYD, John Beckwith, M.SC.(MANC.)
(F) MCGWYNNE, Brendan Dominick, B.SC.(N.U.I.)
(OB) MACINTOSH, Shirley Christina, B.SC.(CAPE T.)
(EE) MORTIMER, John
(T) NASH, Graham Richard, M.SC., PH.D.(WALES)
(F) O'DONOVAN, Daniel Gerrard, B.SC.(N.U.I.)
PARRY-JONES, Thomas, B.SC.(WALES)
(C) PERKINS, Michael John, B.SC.(LOND.)
(H) ROBINSON, Matthew Jenkinson, B.SC.TECH.(MANC.), A.M.C.T.
(K) SMITH, Hamilton, B.SC., PH.D.(GLAS.)
(P) STAPLES, Peter John, B.SC., PH.D.(LOND.)
(K) STEEDMAN, William, B.SC., PH.D.(GLAS.)
(P) THOMPSON, George Anthony, B.SC.(OXON.)
(H) TORRANCE, Anthony Robert, B.SC.(GLAS.)
(P) WHITE, Raymond Frederick Martin, B.SC., PH.D.(LOND.)
(P) WILCOX, Brian, B.SC.(LOND.)

GRADUATE MEMBERS ELECTED TO THE ASSOCIATESHIP

(P) CHADWICK, John Graham
(C) DOWNING, Brian York
(L) EAGLAND, Donald, B.SC.(LOND.)
(Q) GREENSHIELDS, James Nairn, A.R.T.C.S.
(X) KENNEDY, Thomas
(SS) KENYON, John Henry
LAW, Derek Alwyn, B.SC.(LIV.)
(Q) LEACH, Howard Frank, B.SC.(LOND.), A.R.C.S.
(O) MACFARLANE, William Andrew Russell
(D) PALMER, Peter Joseph
(WW) PAXTON, Robert Edgar, A.R.C.S.T.
(P) PERRY, Reginald Gilbert, B.SC.(LOND.), A.R.C.S.
(WW) PHILP, John Michie, A.H.-W.C.
(S) RAPER, Eric Salvin
(K) RICHARDSON, Robert Thomson
(J) ROBERTSON, Alexander, A.H.-W.C.
(Q) ROBINSON, John Barry, M.SC.(MANC.), M.P.S.
(Q) TIPPING, Anthony Edgar
(D) TROTT, Ronald Walter
(Q) WILDE, Bryan Edmund
(K) YEOMAN, David

NEW GRADUATE MEMBERS

(C) CASSERLEY, Barrie, DIP.TECH.(BIRM.)
(C) CHILD, Brian, B.SC.(NOTT.)
(H) GOODWIN, Alan John, B.SC.(LEEDS)
(P) GOODWIN, Raymond Wilbert Lindfield, B.SC.(LOND.)
(P) HEELEY, Anthony Fredrick, B.SC.(WALES)
(P) LIENGME, Bernard Victor, B.SC.(LOND.), A.R.C.S.
(SS) MARSDEN, Peter David, D.L.C.
(J) MUNRO, Alan Loudon Scott, A.H.-W.C.
(P) RADLETT, Douglas Leonard, DIP.TECH.(BRUNEL)
(P) READ, James Franklin, B.SC.(LOND.)
(W) ROWE, David John, B.SC.(LOND.), A.M.INST.GASE., A.M.INST.F.
(P) TYRRELL, Colin John Nelson, B.SC.(LOND.)

CHANGES OF NAME

Ann BARKER to SHEPHERD on marriage
Ann ROBINSON to LINGARD on marriage

DEATHS

Fellows

(P) ANDREWS, Ernest Robert. Died 28 December, 1960, aged 84. *A.* 1897, *F.* 1904.
(G) BALFE, Bernard James, B.SC.(LOND.). Died December, 1960, aged 48. *A.* 1933, *F.* 1944.
(H) BARNES, Harry, B.SC., PH.D.(LIV.). Died 12 December, 1960, aged 60. *A.* 1922, *F.* 1948.
(O) BOND, Edward John, B.SC.(LOND.). Died 22 December, 1960, aged 59. *A.* 1926, *F.* 1939.
(P) BRITTON, Hubert Thomas Stanley, D.SC.(LOND. AND BRIS.). Died 30 December, 1960, aged 68. *A.* 1919, *F.* 1922.
(K) CAMPION, Alfred. Died 9 January, 1961, aged 86. *A.* 1898, *F.* 1901.
(D) CARTER, Dick, M.SC.(LEEDS). Died 3 January, 1961, aged 59. *F.* 1944.
(P) CLAYTON, William, D.SC.(LIV.). Died 1 January, 1961, aged 69. *A.* 1918, *F.* 1922.
(SS) CORY, Harold Edward John, M.SC.TECH.(MANC.). Died 11 November, 1960, aged 71. *A.* 1918, *F.* 1928.
(Q) CRANSHAW, Cecil John Turrell, B.SC.(MANC.), D.SC.(LEEDS). Died 5 January, 1961, aged 71. *F.* 1928.
(E) MARKS, Arthur. Died 16 November, 1960, aged 78. *A.* 1909, *F.* 1912.
(D) TAYLOR, Millicent, B.SC.(LOND.), D.SC.(BRIS.). Died 23 December, 1960, aged 89. *A.* 1919, *F.* 1922.

Associates

(U) BRINDLEY, William Harrison, M.C., M.A.(CANTAB.), M.SC.TECH., HON.M.SC., PH.D.(MANC.). Died 14 January, 1961, aged 72. *A.* 1924.
(U) HENLEY, Eric Semon. Died 10 November, 1960, aged 49. *A.* 1945.
(C) HENLY, Albert Arthur, B.SC., PH.D.(LOND.). Died 15 January, 1961, aged 38. *A.* 1951.
(S) MADGIN, Walter Matthew, D.SC.(DURH.). Died 16 December, 1960, aged 67. *A.* 1919.

LOCAL SECTIONS OF THE INSTITUTE

DIARY OF MEETINGS

Sections are glad to welcome members of other Sections to their meetings and social functions, except when numbers are restricted, as for works visits. Those wishing to attend meetings outside their own area are advised to write to the Hon. Secretary of the Section concerned, as the Institute cannot accept responsibility for any alterations or cancellations. All times are p.m. except where otherwise stated.

(A) **Aberdeen.** 15 Mar. 8. The Lurgi Pressure Gasification Process. D. C. Elgin and Dr J. Linton. Chemistry Department, The University. Joint, C.S. and S.C.I.

(B) **Belfast.** 27 Mar. 7.45. Annual General Meeting. Chemistry Lecture Theatre, Queen's University, Stranmillis Road

(C) **Birmingham.** 22 Mar. 6.30. Annual General Meeting

(N) **Bradford.** 13 Mar. Flash Photolysis. Prof. G. Porter. Institute of Technology

(D) **Bristol.** 23 Mar. Ladies' Night. Frozen Foods. Birds Eye Foods Ltd. College of Science and Technology, Ashley Down

(Q) **Bury.** 23 Feb. 7. The Analyst in the Chemical Industry. H. E. Stagg. Technical College

(P) **Cambridge.** 22 Mar. 7.45. Platinum Group Metals. E. C. Davies. Technological Research Station, Spillers Ltd, Station Road. Joint, S.C.I.

(P) **Chatham.** 2 Mar. 7.30. Some Recent Developments in Gas–Liquid Chromatography. Dr A. T. James. Medway College of Technology, Maidstone Road

(P) **Chelsea.** 8 Mar. 7. Newer Chemistry of Bile Acids and Alcohols. Prof. G. A. D. Haslewood. College of Science and Technology, Manresa Road, S.W.3. Joint, College Chem. Soc.

(O) **Chester.** 2 Mar. 7.30. The Production and Application of Synthetic Rubber. K. G. Burridge. Public Library. Joint, Institute of Petroleum

(G) **Colchester.** 16 Mar. 7.30. Ion Exchange. Dr R. E. Kressman. North-East Essex Technical College

(T) **Connah's Quay.** 8 Mar. 7. Recent Developments in the Physical Chemistry of Steel-making. Sir Charles Goodeve

(H) **Derby.** 23 Mar. 7.30. Annual General Meeting, followed by Film Evening. Lecture Theatre, College of Art

(F) **Dublin.** 8 Mar. Petroleum Refining: A Chemist's View of Today and Tomorrow. E. LeQ. Herbert. University College

(FF) **Dundee.** 17 Mar. 7.15. Modern Textile Fibres. W. R. Beath

(O) **Eastham.** 16 Mar. 7.30. Rocket Propellents. Dr C. H. Johnson. Carlett Park College of Further Education. Joint, S.C.I. and College Chem. Soc.

(P) **Ewell.** 20 Mar. 7. The Chemistry of Fluorine. Prof. R. N. Haszeldine. County Technical College. Joint, College Faraday Soc.

(R) **Fawley.** 1 Mar. 7.30. Developments in Chemicals from Coal. Dr R. R. Gordon. Esso Oil Refinery. Joint, Institute of Petroleum

(K) **Glasgow.** 10 Mar. 7. Annual Business Meeting, followed by Open Meeting (7.30). Retiring Chairman's Address, Some Thoughts on Research and Development. Dr W. A. Caldwell. Room 24, Royal College of Science and Technology

(WW) **Grangemouth.** 23 Mar. 7. Annual General Meeting. Followed by (7.30) Production and Application of Synthetic Rubber. K. G. Burridge. Recreation Hall, B.P. Refinery. Joint, S.C.I. and Institute of Petroleum

(P) **Hatfield.** 7 Mar. 7.30. Some Chemical Problems of Space Flight. D. Hurden. Technical College, Roe Green

(P) **Hendon.** 29 Mar. 7.30. Public Lecture: The Story of Soap and the Growth of Modern Synthetic Detergents. Dr K. G. A. Pankhurst. Technical College

(L) **Huddersfield.** 23 Mar. 7. Annual General Meeting, followed by Scientific Film Evening. Alexandra Chambers, 32 John William Street

(M) **Hull.** 3 Mar. Annual Dinner and Dance. Guildhall
—— 9 Mar. 7.30. Infra-Red Spectra. Dr J. L. Bellamy. Organic Lecture Theatre, The University. Joint, C.S.

(O) **Liverpool.** 17 Mar. Annual Dinner and Dance. G. H. Lee's, Basnett Street

(P) **London.** 4 Mar. 7.30. Buffet Dance. Caxton Hall, S.W.1. Joint, S.C.I.
—— 15 Mar. 2. Symposium. The Soil: Problems Raised by its Use and Misuse. William Beveridge Hall, Senate House, W.C.1. Joint, Institute of Physics and the Physical Society, and Institute of Biology

(Q) **Manchester.** 17 Mar. 7.30. Annual Dinner and Dance. Belle Vue

(X) **Middlesbrough.** 14 Mar. 8. Prof. F. D. Richardson. Constantine Technical College

(S) **Newcastle.** 1 Mar. 6.30. X-Ray Determination of Molecular Vibrations. Prof. Dame Kathleen Lonsdale. Chemistry Department, King's College

(E) **Newport.** 24 Mar. 7. Lecture by Dr E. M. Evans. College of Technology, Allt-yr-yn. Joint, S.C.I.

(W) **Plymouth.** 24 Mar. 4.30. Annual General Meeting. Followed by: Priestley's Airs and Waters. Dr F. W. Gibbs. Technical College

(R) **Portsmouth.** 13 Mar. 7. Some Polysaccharides of the Human Body. Dr A. B. Foster. College of Technology. Joint, Portsmouth and District Chem. Soc.

(SS) **Preston.** 8 Mar. 7.30. Sequestering Agents and their Uses in Industry and Analysis. Dr R. L. Smith. Harris College

(Q) **Rochdale.** 14 Mar. 7.15. Modern Plastics, their Preparation and Uses. R. W. Hall. Technical College, Nelson Street

(O) **St Helens.** 23 Mar. 7.30. The Structure and Stability of Atomic Nuclei. Dr A. A. Jaffe. Technical College

(R) **Salisbury.** 8 Mar. 7.45. Trends in Polymer Developments for the Rubber Industry. Dr L. Mullins. Red Lion Hotel. Joint, Institution of the Rubber Industry

(M) **Scunthorpe.** 23 Feb. 7. The Spectrochemical Analysis of Iron and Steel and Associated Materials. Dr T. S. Harrison. North Lindsey Technical College

(EE) **Seascale.** 17 Mar. 8. New Horizons in Polymer Science. Prof. C. E. H. Bawn. Windscale Club. Joint, S.C.I.

(U) **Sheffield.** 15 Mar. 7.30. The Work of the Chemistry Department. Prof. R. D. Haworth. Department of Chemistry, The University, Brookhill
—— 27 Mar. 7. Public Lecture: Plastics and Fibres. Prof. C. E. H. Bawn. Chemistry Lecture Theatre, The University, Brookhill

(C) **Stoke.** 16 Mar. 7.30. Principles and Possible Applications of Radiation Chemistry. Prof. F. S. Dainton. College of Technology

(G) **Stowmarket.** 28 Mar. 7.30. New Organic Surface Coatings. M. W. Thompson

(V) **Swansea.** 10 Mar. 6. Vapour-Phase Chromatograpy. A. Verdin. Department of Chemistry, University College. Joint, S.A.C.

(P) **West Ham.** 2 Mar. 7. Chemicals from Acetylene. Dr S. A. Miller. College of Technology, Romford Road, E.15

(O) **Widnes.** 9 Mar. 7. Infra-Red Spectroscopy. Dr R. G. Lloyd. Technical College

(C) **Wolverhampton.** 10 Mar. 7.30. The Chemical Aspects of Fire Protection. F. E. T. Kingdon. Wolverhampton and Staffordshire College of Technology. Joint, Wolverhampton Society of Applied Science

HON. SECRETARIES (GREAT BRITAIN AND IRELAND)

	Section	*Hon. Secretary*
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(B)	Belfast and District	**R. J. Magee,** M.SC., PH.D., F.R.I.C., 255, Holywood Road, Belfast
(C)	Birmingham and Midlands	**J. E. Gregory,** B.SC., PH.D., F.R.I.C., 5, Silvermead Road, Sutton Coldfield
(D)	Bristol and District	**J. H. Weber,** B.SC., F.R.I.C., The Imperial Tobacco Co. Ltd, Research Department, Raleigh Road, Bristol, 3.
(E)	Cardiff and District	**R. C. F. Stephens,** F.R.I.C., Skelmorlie, Stow Park Circle, Newport, Mon.
(EE)	Cumberland and District	**A. Naylor,** B.SC., PH.D., A.R.I.C., 21, Santon Way, Seascale, Cumberland
(F)	Dublin and District	**J. T. O'Herlihy,** B.SC., F.R.I.C., 21, Ballymun Avenue, Ballymun, Dublin
(FF)	Dundee and District	**K. R. Hargreaves,** B.SC., PH.D., F.R.I.C., Chemistry Department, The Technical College, Bell Street, Dundee
(G)	East Anglia	**R. J. Nunn,** B.SC., A.R.I.C., 41, Crofton Road, Ipswich, Suffolk.
(H)	East Midlands	**R. W. Hale,** B.SC., F.R.I.C., Blakeney, Tollerton Lane, Tollerton, Nottingham
(J)	Edinburgh and East of Scotland	**K. A. Scott,** A.R.I.C., Department of Pharmacology, University New Buildings, Teviot Place, Edinburgh, 8
(K)	Glasgow and West of Scotland	**W. Gibb,** B.SC., PH.D., A.R.T.C., A.M.INST.F., A.R.I.C., Department of Chemical Technology, Royal College of Science and Technology, George Street, Glasgow, C.1
(L)	Huddersfield	**F. W. Jarvis,** B.SC., F.R.I.C., 577, Bradford Road, Bradley Bar, Huddersfield
(M)	Hull and District	**L. Malin,** B.SC., F.R.I.C., The Universal Oil Co. Ltd, Oak Road, Newland, Hull
(N)	Leeds Area	**W. A. Wightman,** M.A., F.R.I.C., The University, Leeds, 2
(O)	Liverpool and North-Western	**H. R. Jones,** B.SC., F.R.I.C., The Centra College of Further Education, Carlett Park, Eastham, Wirral
(P)	London	**G. C. Ackroyd,** B.SC., A.R.I.C., Second Floor, 107, Cheapside, London, E.C.2
(Q)	Manchester and District	**R. Shackleton,** F.R.I.C., Magnesium Elektron Ltd, P.O. Box No. 6, Clifton Junction, Manchester
(R)	Mid-Southern Counties	**T. F. McCombie,** F.R.I.C., 50, Springdale Avenue, Broadstone, Dorset
(S)	Newcastle upon Tyne and North-East Coast	**H. L. Hutton,** B.SC., F.R.I.C., 26, Long Close Road, Hamsterley Mill Estate, Rowlands Gill, Co. Durham
(SS)	North Lancashire	**R. E. Wilson,** B.SC., A.R.I.C., 315, Blackpool Road, Preston, Lancs.
(T)	North Wales	**S. McLintock,** B.SC., F.R.I.C., Chemistry and Metallurgy Dept, Flintshire Technical College, Connah's Quay, Nr Chester
(U)	Sheffield, South Yorkshire and North Midlands	**J. D. Hobson,** B.SC., PH.D., A.MET., A.I.M., F.R.I.C., 38, Springfield Avenue, Millhouses, Sheffield, 7
(V)	South Wales	**H. E. Hallam,** M.SC., PH.D., A.R.I.C., University College, Singleton Park, Swansea
(W)	South-Western Counties	**B. M. Dougall,** M.SC.AGRIC., F.C.S., A.R.I.C., Chemistry Dept, Seale-Hayne Agricultural College, Newton Abbot, Devon
(WW)	Stirlingshire and District	**R. W. Rae,** A.H.-W.C., A.R.I.C., Nappyfaulds House, By Falkirk, Stirlingshire
(X)	Tees-side	**G. H. Mansfield,** B.SC., PH.D., A.R.I.C., 86, Harlsey Road, Hartburn, Stockton-on-Tees, Co. Durham
(Y)	Thames Valley	**A. D. Jenkins,** B.SC., PH.D., F.R.I.C., Gillette Industries Ltd, Research Laboratory, 454 Basingstoke Road, Reading, Berks.